THE

INDUSTRIES OF RUSSIA

MINING AND METALLURGY

WITH A SET OF MINING MAPS

BY

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MINING ENGINEER

FOR THE

WORLD'S COLUMBIAN EXPOSITION

AT

CHICAGO

EDITOR OF THE ENGLISH TRANSLATION

JOHN MARTIN CRAWFORD

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PREFACE.

The mining industries, which constitute one of the chief branches of national economy and whose products form the most important objects of national wealth and consumption, undoubtedly deserve special attention among the various branches of industry of the Empire.

The present review of the Russian Mining Industries was written for the World's Columbian Exposition at Chicago, 1893, and its main object is to acquaint foreign countries with the position of the industry in Russia. This work has been based upon the facts and data given in the official mining and metallurgical statistics annually published by the Mining Committee of Engineers, and the author has endeavoured to group these data in the clearest form possible and to elucidate them by giving the reasons which have brought the separate branches of the industry to their present position. Therefore, notwithstanding the brevity of the present review, it was impossible to neglect the historical side of the development of the mining industry in Russia. This side of the subject is both treated in the introduction and in the historical sketches of the rise and progress of the individual branches of mining and metallurgical works.

But as the statistical data alone of the production of the objects of this industry cannot give the possibility of form-

ing a conception of the extent to which the home industry corresponds to the national demand, inasmuch as this demand progresses and satisfies itself by interchange of these commodities with other countries, therefore the author has thought best to answer these questions by giving further data collected from various sources. And lastly, upon the suppositions that the acquainting of foreign countries with the position of the Russian mining industries may tend to incite commercial relations with other countries, which do not at present carry on any interchange with the products of the Russian Mining Industry, the author enumerates those countries which already participate in such interchange of trade, and cites the duties laid upon the importation of foreign products by the tariff of 1891. The extent of these duties also clearly indicates the protective policy required by each of the individual branches of this industry.

A. Keppen,
Mining Engineer.

PREFACE
TO THE
ENGLISH TRANSLATION.

A visit to the Imperial Hermitage at St. Petersburg will impress even a casual observer with the great variety and marvellous beauty of the jasper, porphyry, lapis lazuli, malachite and other semi-precious stones brought from the mines and quarries of the Empire to adorn the National Museum and Gallery of Arts. In like manner a visit to the Mineralogical and Mining museums of the Russian Capital will convince the specialist of the wonderful wealth of precious stones, noble metals, and other valuable minerals found in the different regions of this vast country.

In these pages Mr. A. Keppen, Mining Engineer, has given a scientific, interesting and very instructive resumé of the mining industries of Russia, together with an historical description of their birth and development in the several portions of the Empire; he has also given a detailed and carefully tabulated account of the commercial importance of the many products of the Russian mines, and with the aid of maps has carefully pointed out the most important localities of the principal deposits. In this work Mr. Keppen has been aided by the official figures of the Mining Department, Ministry of Imperial Domains.

In the editing of this translation I have sought to render the compound consonants of the Russian language, and especially

the geographical and other proper names, into English after a simple and uniform method. Therefore, case and gender endings, particularly of adjectives, have been dropped. To illustrate, the very common adjective terminations, ***скій, ская, ское*** (skoi, skaĭa, skoĭe), used to designate the genders, have been shorn of their final vowels, and the reader will consequently find such expressions as the *Dombrovsk* Mining School, instead of the varying forms, *Dombroffsky, Dombrofsky, Dombrowski, Dombrovsky,* or *Dombrovskaĭa* Mining School. However, such proper names as have become fixed with any degree of uniformity in English books have been retained in their familiar dress, although the orthography be erroneous, as Kirghiz for *Kirgiz,* and Ural mountains for *Uralsk* mountains.

In this connection I wish to call attention to the list of errors to be found at the end of this work, and to say, as in the Preface to Manufactures and Trade of Russia of this series of volumes, that this translation has been made in very great haste, and that the typographical work has been done by casemen unfamiliar with the English language, thus making it extremely difficult to avoid errors. In this instance, however, the more important mistakes of this kind, especially such as were apt to be misleading, have been corrected in the table of Errata at the close of the volume.

In presenting this translation of the Mining and Metallurgy of Russia to the visitors of the World's Columbian Exposition at Chicago, I feel confident that the authentic information contained in these pages will be of practical value to those who are interested in the great mining industries of the United States; and it was in this conviction that I accepted the labour of this Edition.

J. M. Crawford.

St. Petersburg, Aug. 11, 1893.

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RUSSIAN WEIGHTS AND MEASURES.

The following tables will serve to define the Russian weights and measures in terms of the French Metric System, as also in those which are used in the United States.

I. Long measure.

The lineal measures of Russia have for a unit the foot, which, according to the laws of Peter the Great, is the same as the English foot.

1 Russian foot	= 1 English or United States foot.
»	= 12 inches = 120 lines = 1,200 points.
»	= 0·304794 metres = 30·4794 centimetres.
1 Russian arshine	= 16 vershocks = 28 inches.
»	= $2^{1}/_{3}$ feet = $^{7}/_{9}$ or 0·77778 yards = 0·71118 metres.
1 Russian sagene	= 7 feet = 3 arshines.
»	= 2·13356 metres = 213·356 centimetres.
»	= 2·3333 yards.
1 Russian verst	= 500 sagenes = 3,500 feet.
»	= 1066·78 metres = 1·06678 kilometres.
»	= 0·66269 English miles.

II. Square measure.

1 square sagene	= 49 sq. feet = 4·5521 sq. metres.
»	= 5·4444 sq. yards.
1 dessiatine (Russian land measure)	= 2,400 sq. sagenes.
»	= 1·0925 hectars = 2·6997 acres.
1 square verst	= 250,000 sq. sagenes = 104·17 dessiatines.
»	= 1·1380 sq. kilometres.
»	= 0·43916 sq. English mile.

III. Cubic measure.

1 cubic sagene	= 343 cubic feet.
»	= 9·712 cubic metres.
»	= 12·704 cubic yards.

IV. Avoirdupois weight.

1 poud	= 40 Russian pounds = 0·01638 metric tons = 16·380 kilograms.
»	= 0·32243 cwt. or 32·243 Eng. lbs.
1 Russian pound	= 32 lots = 96 zolotniks = weight of 25·019 cubic inches of water at $13^{1}/_{3}$° R. in vacuo.
»	= 0·40951 kilograms = 409·51 grams.
»	= 0·90282 English pounds.

Troy weight.

1 zolotnik	= 96 dolee.
»	= 4·2657 grams.
»	= 65·830 grains, Troy.

INTRODUCTION.

THE birth of a true mining and metallurgical industry in Russia and the institution by the Government of systematic measures for its encouragement date only from the seventeenth century. Although before this the beginnings of a metallurgical and salt industry did exist in various parts of European Russia and Siberia, still strictly speaking, metallurgical works, in the present sense of the word, were only first founded in the reign of Peter the Great, who in 1700 also established the first separate official mining administration, known as the "Prikase of Mining Affairs".

At the end of the year 1719 the Mining College was established for the administration of mining affairs and of the artillery. An ukase of Peter the Great dated December 10, 1719, and entitled the "Mining Privilege", forms the first Russian mining law, and the basis of all subsequent governmental measures for the regulation of mines. The Mining Privilege proclaimed an entire freedom in the establishment of a mining industry in Russia, with the right to prospect for ores and all kinds of mineral deposits not only on governmental property and on that of the prospectors, but also on the lands of other proprietors, even without their consent. In case of the appropriation of the property of others for metallurgical works or mines, the owners of the enterprise were obliged to pay the landowner a thirty-secondth part of the profits, besides a special indemnification for the lands occupied by the mines and works, and for the forests required to supply fuel for the furnaces. The workmen employed in mines and metallurgical works were exempted from all taxation and also from military service.

Furthermore, Peter the Great, recognizing the imperial right over all the mineral wealth of the land, instituted a Government tax of one-tenth of the production of all mines. In 1720 he issued ukases to the effect that no one should dare to impede the development of the mining industries, and also authorizing the importation of foreign workmen for employment in Russian works and mines. The most active helpers of Peter the Great in increasing the number of metallurgical works in various parts of Russia, in the Government of Tula, Olonets and the Urals, were Wilhelm de Hennin of Saxony, Tatischev and Nikitin Demidov, a merchant of Tula. De Hennin among other things founded the town of Ekaterinburg and established there the first mining school in Russia.

Even to his death the Great Reformer devoted unceasing and especial care to the development of the mining industry and to the organization of a mining administration in Russia, and thereby gave a firm basis for the growth of this important branch of national wealth. But the elements of mining freedom which were at the basis of the Mining Privilege were not destined to receive that further development for which they were especially intended, nor did they give that impetus to mining matters that might have been assuredly expected had they been properly cultivated. These elements did not remain

in force in Russian legislation for more than sixty years, and during that time the Mining Privilege did not remain without additions and alterations. The Empress Catherine I, by an ukase dated 1727, endeavoured to facilitate the mining industries in distant parts of the Empire, and more especially in Siberia.

In the reign of the Empress Anna Ioanovna the mining administration underwent a further modification, and in 1736 the Mining Privilege was annulled, and a Government Mining Direction was established for the administration of such affairs. On the recommendation of the all-powerful Biron, Baron von Schemberg a native of Saxony was nominated the first director of this office. In 1739 an ukase was issued entitled the Mining Regulations. The most important point in this ukase was the handing over of all the State works, with the exception of Mount Blagodat in the Urals and the copper-mines of Lapland, to the management of private individuals and companies. The iron works on Mount Blagodat were placed under the direction of Schemberg himself. During the administration of the Mining Directorium the works which had been distributed among private individuals fell into a state of the utmost disorder and mismanagement, in consequence of which the Empress Elizabeth Petrovna, in 1742, abolished the Mining Direction, ordered the works to be removed from Schemberg's hands and reestablished the Mining College. The discovery of gold in the neighbourhood of Ekaterinburg in the Berezovsk mines, and the smelting of auriferous silver ores of the Altai mountains at Demidov's works, which from that time passed over to the State, were the most important mining events of the reign of the Empress Elizabeth Petrovna.

The idea of founding a higher mining school in St. Petersburg, which first arose at the close of the reign of the Empress Elizabeth, was only fulfilled during the reign of the Empress Catherine, in 1773. In 1775 the administration of mining affairs in Russia underwent an entire reorganization. Soon after the subdivision of the Empire into governments, it was decreed by an Imperial ukaze, that the mining affairs should be given over to the administration of the local state tribunals by means of special mining commissions. This arrangement brought the metallurgical works of Russia and especially of the Urals into a state of perfect decadence.

In the mining legislation of the Empire the Empress Catherine II took an exactly opposite view from that of Peter the Great in his Act of Privileges. This was brought about by a manifesto dated June 28, 1782, by which the landowners were endowed with a freedom in the disposition of their lands and a right over, not only their superficial area, but also over all the minerals contained beneath, and over the metals produced from such minerals. The main principles of this manifesto remain in force up to the present day. The unsatisfactory management of the metallurgical works of the Empire already called forth certain modifications in the mining administration during the close of the reign of Catherine II, and induced the Emperor Paul, on his accession to the throne, to separate the direction of the mining affairs from the state tribunals, and to re-found the Mining College. The Emperor Paul, on the recommendation of the director of the Mining College, Saymonov, despatched exploring expeditions to various parts of the Empire with a view to the discovery of new mineral deposits and to make a mineralogical survey of the country.

On the formation of the Imperial Ministries by Alexander I, in 1802, the Mining College was subordinated to the Ministry of Finance, and in 1806 it was ultimately abolished and the Mining Department established in its place. In the reign of the Emperor Alexander the name of Derzabin is especially memorable in the administration of min-

ing affairs, as that of the author of a "Project of an Act for the Regulation of Mines", edited July 13, 1806. It was at first proposed to try this project for a period of five years, from 1807 to 1812, and then, after revision, to ultimately confirm it; however owing to the events of those times, it was never revised, but remained in force until the first edition of the code of laws into which it entered in the form of a mines statute. In 1811 the salt industry was also brought under the supervision of the Mining Department. In 1825 the Mining Journal was first published at the instigation of the director Karneev of the Mining Department, under Count Kankrine. This Journal was published with a view to supplying the most recent information concerning mining and metallurgical matters.

During the reign of Emperor Nicolas the mining industry made rapid progress both in its scientific as well as in its technical and administrative aspects. Numerous mining surveys and expeditions were made in various parts of the Russian Empire. And here mention should be made of the expeditions made in 1829, under the special patronage of the Emperor Nicolas, by Alexander von Humbolt and his fellow travellers Gustave Rose and Erenberg, and of the geological survey made by the English savant Murcheson together with the French paleontologist de Vernien and Count Kaiserling. This survey embraced the whole of European Russia and the Urals. Besides these the expedition conducted by Demidov in the south of Russia, with the French savant Le Play at its head, should be mentioned, as also the exploration of the Caucasus and Crimea by Dubois de Monpere, and of the Altai by Chikachev. To this reign also belong the geological researches of the Russian geologists, Schourovsky, Eichwald, Helmerson, Hoffmann and others.

The great reforms made by the Emperor Alexander could not but have their influence on the mining industries. The most important of them, namely, the liberation of the serfs in 1861, brought about a complete revolution in the position of the mining industry of Russia, which in its immediate and possible future consequences must be acknowledged as more important than all the modifications which the Russian Mining legislation had undergone up to that date. The abolition of obligatory serf labour, upon which the entire Russian mining production was, like all other industries, dependent, could not but produce a radical reform in the economic aspect of the industry and in the position of the mining population. With it the responsibilities and duties of the mining administration also inevitably underwent a substantial change. The Government administration having up to 1861 immediately directed the labours of the very considerable number of workmen employed in the state works, and being called upon to guard over the relations held towards the labourers of private works whose proprietors were in their turn more or less the perfect disposers of the labour of their own serfs, was unable to limit itself to purely mining affairs, but was necessarily obliged to take upon itself many of the duties of a general state direction. Thus the mining department had its own police, its court of justice, inspection of schools, hospitals, churches and even its own post. After the liberation of the mining population from obligatory labour, such a union of most varied duties under one administration lost its meaning, and from that time began, so to say, the process of the specialization of the mining administration.

It will be sufficient to cite only the most important of the many measures adopted for the protection of the mining industry during the reign of the Emperor Alexander II. The introduction in 1862 of an excise upon salt led to the withdrawal of the entire and vast salt business of the Empire from the jurisdiction of the Mining Depart-

ment. The Imperial Mints were also separated in 1872, and the abolition of the tax upon crude naphtha led to the inspection of the private naphtha trade being given over to the Mining Direction.

Among the legislative measures of that period mention must be made of the following, having special reference to mining matters:

1. The publication in 1870 of a statute respecting the private gold workings, in which rules were laid down regulating the gold production for the whole Empire; also many other measures respecting the extensive development and encouragement of the gold industry.

2. The declaration of a free naphtha trade and the publication of a special law respecting its production.

3. The giving of special bounties for the encouragement of the preparation of sulphur from pyrites.

4. The abolition of the salt monopoly and the permission of a free production and sale of salt, together with the subsequent introduction of the excise system of the salt revenue in 1862.

5. The publication in 1870 of a new mining law for the governments of Poland on the principle of separating the rights of the landowner from the minerals under his lands.

6. The formation of an Institute of district mining engineers for the inspection of private mines and works.

During the reign of the Emperor Alexander II the mining tributes were one after another subjected to revision, which in general resulted in their being abated, and in some cases abolished. In 1874 the Mining Department was transferred from the Ministry of Finance to the Ministry of State Domains.

Geological surveys and prospectings for mineral deposits were most actively conducted during the reign of the Emperor Alexander II. These surveys embraced every kind of minerals and extended from the frontiers of Germany and Austria over the whole of European and Asiatic Russia, as far as the shores of the Pacific ocean and the adjacent island of Sakhalin, on the one hand, and from the Mourman shores of the Arctic ocean and the mouths of the Petchora to the southern base of the Caucasus and the very heart of central Asia, the unexplored Pamir, on the other. It cannot but be recognized that such explorations must have borne important results both for science and for the development and extension of the mining production of Russia. These explorations, for example, called particular attention to the coal fields, salt and naphtha springs, and also to the iron ores of the south of Russia. Lastly it was during the reign of the Emperor Alexander II that the first meetings of mine owners and metallurgists were held in the various mining centres of Russia for the purpose of discussing the requirements of entire mining districts and of individual branches of the mining and metallurgical industries. Starting from 1881, a series of very important changes were made in the mining administration and legislation of the Empire. The abolition of the excise upon salt and its removal from the control of the Ministry of Finance considerably extended the range of action of the general mining direction. The formation of new mining regulations in western and eastern Siberia and in southern Russia, together with the reorganisation of the existing mining direction of the Urals and Caucasus, increased the powers of the local mining administrations. The relations between the owners on the one hand, and the workmen on the other were regulated by applying the already existing factory law to the private mining and metallurgical industries.

Among the legislative measures of this reign the following should be mentioned as having special reference to mines:

a. The extension of the mining law of 1870 for Poland, by which the expropriation of the subsoil minerals was applied to iron in addition to coal, zinc, and lead ores.

b. The publication of a new law respecting the naphtha industry.

c. The imposition of a tax upon the pig iron and zinc smelted in Poland.

d. The imposition of a tax upon gold with every possible facility for the payment of such a tax.

e. The publication of a law for the preservation of mineral springs.

f. The publication of a special law referring to private mines and works upon free Crown lands. This is a category of lands which plays a very important part in Russia, and for which the Government has never discredited the principle of so-called mining freedom, which Peter the Great placed as the basis of his mining legislation.

The brilliant scientific and practical results attained by the geological surveys of western Europe and the United States induced the Russian Government to found a special geological institute for the purpose of making a systematic geological survey of the Empire. This institute was established in 1882, under the name of the Geological Committee. Its chief aim was the compilation of a general geological map of Russia, together with a systematic description of its formations. The work conducted by the Committee resulted in a substantial modification of the previous geological data for almost all the districts surveyed by them.

Having terminated the historical review of the various changes which the mining administration and legislation underwent from the time of Peter the Great, the present organisation of the mining administration and the mining legislation now in force, may may be discussed.

The direction of the mining affairs of Russia, exclusive of Finland, is mainly concentrated in the Mining Department of the Ministry of State Domains. The only exceptions are the mining and metallurgical industries of the Province of Don Cossacks, which are under the supervision of the Ministry of War, and also the metallurgical works of the Altai and Nerchinsk mining districts of Siberia which are under the management of His Majesty's Cabinet, forming a part of the Ministry of the Imperial Court. It should be remembered that as the mining industries include besides mines the metallurgical works, the mining administration directs not only the raising of ores, but also their mechanical, metallurgical and chemical treatment. The naphtha industry however forms an exception and is subject to the Ministry of Finance.

The Government works and mines are divided into districts, each of which is under the supervision of a special mining inspector. There are four such districts in the Urals, one in northern Russia and one in Poland. The head direction of the Ural districts belongs to the chief inspector of the Government Ural works, who also controls all the private mining industries within these districts. The private works and mines are under the inspection of district engineers, eight in the Urals, four in southern Russia, two in central Russia, three in Poland, one in northern Russia, four in the Caucases, six in western and six in eastern Siberia. The district engineers have an immediate control over the private metallurgical works and mines of their districts and thus form the link between them and the chief mining administration. In certain parts of Russia there are mining directions to which the local district engineers are subordinate. There

are five such directions, one at Ekaterinburg over the Ural districts, one at Ekaterinoslav over the south of Russia, one at Tiflis over the Caucasus, one at Tomsk over western Siberia and one at Irkutsk over eastern Siberia. The district engineers of the two districts of central Russia, of the three districts of Poland and of that of northern Russia, are subordinate to the Mining Department at St. Petersburg. There is a mining direction also in the province of the Don Cossacks. This direction includes a special section for the salt industry and has three district engineers attached to it. The Altai and Nerchinsk mining districts are controlled by mining inspectors who are directly subordinate to His Majesty's Cabinet. There is a special mining direction in Finland.

As regards the mining laws of the Empire, they are published in the seventh volume of the Code of Laws. Many additions and alterations have however been made to this code since its first publication in 1857. Some of these modifications bear a purely local character while others refer to the exploitation of certain minerals. To the first category belong:

a. Rules for the mining industry of the province of the Don Cossacks.
b. Rules for the mining industry of Poland.
c. Rules for private mining enterprises on free state lands.
d. Rules for the coal mines of the island of Sakhalin.
e. Rules for the amber industry on state lands.

To the second category belong:

1. Rules for private gold workings.
2. Rules for the naphtha industry.
3. Rules for the salt industries.

There has been no possibility of publishing a general and systematic mining code because the Government has been and is still making a gradual revision of the original code, since its publication in 1857. In the Grand Duchy of Finland however the original code is still in force.

The following table gives a general view of the production of the mining and metallurgical industries during the reigns of the Emperors Nicholas, Alexander II and Alexander III, that is, from 1825 to 1890.

Years.	Gold.	Silver.	Platinum.	Copper.	Lead.	Zinc.	Pig iron.	Coal.	Salt.	Naphtha.
			P		o		u	d	s.	
1825	237	1,140	11	203,000	—	—	9,644,500	—	—	—
1830	383	1,282	107	236,000	42,400	—	11,169,300	—	20,920,400	—
1835	393	1,212	105	240,200	42,500	153,450	10,501,100	—	22,500,000	—
1840	458	1,205	93	251,600	54,400	167,200	11,331,500	—	26,550,000	—
1845	1,307	1,192	47	254,700	55,900	217,900	11,432,600	—	55,477,000	—
1850	1,454	1,068	10	393,600	41,200	159,100	13,892,300	—	24,829,000	—
1855	1,649	1,100	1	378,600	110,900	67,600	15,310,600	9,494,000	31,559,000	—
1860	1,491	1,070	61	317,100	66,700	112,200	20,467,500	18,309,000	26,232,500	—
1865	1,576	1,084	139	253,000	99,700	188,600	18,280,700	23,331,000	30,638,800	556,900
1870	2,163	868	119	308,400	100,700	230,800	21,949,400	42,416,500	29,013,500	1,704,450
1875	1,996	601	94	222,800	66,000	243,300	26,079,700	104,348,000	35,738,700	8,074,400
1880	2,642	616	180	195,500	70,000	267,800	27,364,400	200,784,000	47,531,900	21,498,000
1885	2,016	687	158	288,250	43,650	279,900	32,205,500	260,577,500	69,180,400	116,258,900
1890	2,403	889	173	349,500	51,100	230,400	56,560,000	367,203,500	84,857,200	242,941,600

Taking the figures giving the production of the most important branches of the mining industry for 1890, their values are found to be as follows:

	Weight.	Value.
	Pouds.	Roubles gold.
Gold	2,155	30,402,900
Silver	1,011	923,400
Platinum	173	692,000
Copper	349,500	2,796,000
Lead	51,100	51,000
Zinc	230,400	553,000
Mercury	17,835	535,000
Tin	800	8,000
Pig Iron	56,560,000	22,624,000
Coal	367,203,500	12,852,200
Salt	84,857,200	3,394,300
Naphtha	242,941,600	9,717,700
Manganese ore	11,139,700	389,900
Sulphur	9,800	5,500

The amounts of gold and silver here given do not agree with those in the preceding table, as the value of these metals are calculated from the quantity of chemically pure metal obtained in 1890, as further explained in the articles on gold and silver. Thus in 1890 the total value of the chief products of the mining industries of Russia amounted to 85,945,200 roubles gold, or 62,491,200 dollars.

The following table, giving the amount and value of the exports and imports of the chief products of the mining industry, shows how far the present production satisfies the internal requirements of the Empire:

Imports.	Weight.	Value.	Exports.	Weight.	Value.
	Pouds.	Roubles gold.		Pouds.	Roubles gold.
Copper and alloys	256,700	2,960,200	Platinum	207	1,115,600
Lead	1,899,900	8,400,500	Copper	5,300	73,200
Zinc	329,800	1,255,000	Lead	3,300	6,200
Mercury	358	12,000	Mercury	13,850	642,900
Tin	161,000	1,653,500	Pig iron	8,200	7,650
Pig iron	8,132,800	5,277,400	Iron and steel	314,700	743,800
Iron and steel	6,790,100	14,671,400	Other metals	7,200	32,900
Coal	94,008,000	10,840,500	Coal	834,700	88,200
Coke	12,292,250	1,614,700	Salt	456,100	75,500
Salt	1,052,300	289,700	Naphtha and products	48,089,300	27,637,000
Naphtha and products	29,400	106,400	Manganese and other ores	8,602,300	3,348,000
Mineral waters	184,100	87,200			
Sulphur	1,153,400	1,028,000			

Hence in 1890 the total value of the imported mining products amounted to more than 43,000,000 roubles, while the value of the exports was 33,750,000 roubles. If the cost of freight be deducted from the value of the imports it will be found that their value equalled that of the exports.

The number of men employed in the mining industries has approximately increased during the last twenty years as follows:

Years.	Total number of workmen.	Years.	Total number of workmen.
1870	223,400	1885	349,300
1875	268,000	1886	356,300
1880	283,400	1887	398,200
1881	280,400	1888	419,100
1882	314,000	1889	416,900
1883	323,000	1890	435,700
1884	330,750		

During the last five years the number of men occupied in the different branches of the mining and metallurgical industries has varied as follows:

	1886.	1887.	1888.	1889.	1890.
Gold and platinum mines	74,950	85,643	89,215	90,023	87,961
Argentiferous lead	5,738	4,279	5,532	4,852	4,996
Copper	7,487	9,016	9,812	10,239	11,458
Zinc	1,149	1,220	1,299	577	979
Iron	197,488	224,737	230,850	216,637	238,654
Mercury	70	206	282	702	687
Coal mines	33,158	32,781	37,957	43,275	40,571
Manganese mines	1,138	1,318	873	829	3,096
Other metallic mines	—	15	2,392	1,464	496
Sulphur mines and works	250	157	88	35	38
Naphtha industry	3,051	4,102	3,348	4,793	5,994
Asphalt	349	430	452	408	378
Salt	16.194	19,027	14,385	19,607	19,102
Phosphorite clay and quarries	11,639	11,181	22,012	22,984	21,201

On comparing the figures of this table with those giving the production of the different industries one is struck with the much larger production per man attained in foreign countries. It must however be remembered that in Russia mineral fuel still plays a very insignificant part in metallurgical operations and that the preparation of charcoal occupies the time of a large proportion of the men employed in these industries, and accounts for the disadvantage under which Russia suffers in this respect.

The following table shows the distribution of the workmen according to the different districts and branches of mining industry for the year 1890:

Classes of Industry.	Urals.	Central Russia.	Poland.	S. and S.W. Russia.	Caucasus.	Trans-Caspian and Turkestan.	N. Russia.	W. Siberia.	E. Siberia.	Finland.	Total.
Gold workings	44,086	—	—	—	—	—	—	9,512	28,242	268	82,108
Platinum workings	5,853	—	—	—	—	—	—	—	—	—	5,853
Argentiferous lead mines	20	—	—	—	186	—	—	2,356	410	—	2,972
» » works	—	—	—	—	110	—	—	1,864	50	—	2,024
Copper mines	2,532	—	—	—	1,292	—	28	103	—	120	4,075
» works	4,742	—	49	—	1,668	—	107	182	—	635	7,383
Zinc mines	—	—	419	—	—	—	—	—	—	—	419
» works	—	—	560	—	—	—	—	—	—	—	560
Mint	—	—	—	—	—	—	324	—	—	—	324
Iron mines	22,816	3,597	3,935	2,146	10	—	—	176	51	46	32,777
» works	142,241	22,157	7,441	13,552	—	—	10,652	454	1,249	3,131	200,877
Coal mines	2,426	2,452	8,692	25,195	370	162	4	757	513	—	40,571
Manganese mines	47	—	—	482	2,567	—	—	—	—	—	3,096
Cobalt, chromiron and other mines	370	—	—	—	38	—	—	88	—	—	496
Sulphur mines and works	—	—	—	—	35	3	—	—	—	—	38
Naphtha industry	—	—	—	70	5,886	3	—	—	—	—	5,959
Kerosene works	—	949	—	20	3,248	—	292	—	—	—	4,509
Asphalt works and beds	—	291	—	—	60	27	—	—	—	—	378
Salt rock	410	—	—	503	257	—	—	—	—	—	1,170
Salt self deposited	136	—	—	11,030	347	—	—	2,377	74	—	13,964
Salt evaporated	2,907	—	45	388	5	—	178	—	355	—	3,873
Phosphorite	—	60	—	104	—	—	—	—	—	—	164
Glauber salt	45	—	—	—	16	—	—	34	—	—	95
China clay	—	—	—	760	—	—	—	—	—	—	760
Stone quarries	1,060	100	1,131	12,699	1,440	—	—	13	—	—	16,443
Fire clay and bricks	2,083	156	174	1,344	68	—	35	198	—	—	4,058
Mercury mines and works	—	—	—	687	—	—	—	—	—	—	687
Total	231,774	29,762	22,446	68,980	17,603	195	11,615	18,114	30,944	4,200	435,633

The province of Turgaisk is adjoined to the Urals, and the Kirghiz steppes to western Siberia. In the Urals, central Russia and Poland, where the mining industry has long taken root, local workmen are chiefly employed. This however is not the case in southern and northern Russia nor in Siberia, where in only a comparatively small number of cases has a purely mining population begun to settle around the mining centres. This economical importance of the mining industries to the state is to a certain extent revealed in the following table, giving the revenue acquired in the form of dues and other tributes collected from private mining and metallurgical enterprises:

Years.	Gold and platinum.	Pig iron.	Copper and other metals.	Salt.	Naphtha and its products.
	Roubles.				
1855	3,281,700	769,700	769,700	9,133,600	—
1860	2,069,800	446,900	300,200	8,212,900	—
1865	2,001,000	423,850	336,000	10,785,500	—
1870	2,740,800	412,600	46,000	11,956,300	—
1875	1,972,200	349,900	87,100	11,283,500	—
1880	712,100	307,100	47,200	15,598,300	—
1885	2,368,000	426,300	173,300	645,200	—
1890	3,375,600	573,700	157,000	474,000	10,658,000

The causes influencing the fluctuations shown in the above table will be explained in speaking of the separate industries.

Mining Schools and Institutes.

In Russia a higher mining education is given at the Institute of Mines at St. Petersburg, while a more elementary is obtained at the Ural, Barnaoulsk and Dombrovsk mining schools, at the Lisichansk Overmen's School and at Poliakov's Mining School. Al these educational establishments with the exception of the Barnaoulsk school are under the supervision of the Ministry of State Domains. The Barnaoulsk School, being situated in the Altai mining district, is under the control of His Majesty's Cabinet. Besides which the Ministry of Public Instruction has recently organized lower and middle class technical schools throughout the Empire. These schools give instruction in mining among other subjects. At the present time the Ministry has two such schools under its supervision within the limits of the Ural mining districts.

The Mining Institute was founded by the Empress Catherine II by an ukase dated October 21, 1773, at the request of the owners of the Bashkir gold mine for the purpose of supplying competent engineers to direct the mines and metallurgical works of the Empire. Up to 1865 it was known as the Mining Cadet Corps, and was organized after the pattern of military shools. It bore a brilliant reputation not only for the competent mining engineers which it turned out, but also for the general education which it gave, and a long list could be made of the distinguished statesmen and men of every profession who received their education at the Mining Cadet Corps. In 1866 the

Mining Institute was reorganized and its character completely changed. It was converted into a civil establishment and higher school for purely mining matters. The course of study covers five years. The Mining Institute receives a yearly Government grant of 138,000 roubles, 16,000 of which go to scholarships and 12,700 for special assistance of the students. At the present time there are three hundred students in the Mining Institute. The Institute possesses a library, chemical laboratory and museum, which is famous for its collection of minerals; its paleontological and geological collections are also very extensive.

The Ural Mining School, situated in the town of Ekaterinburg, and the Barnaoulsk School in the town of Barnaoul, were founded at the very birth of the mining industry in the Urals and Altai, the Ural school being founded in 1721 and the Barnaoulsk in 1779. The Lisichansk Overmen's School and Poliakov's Mining School are situated in the neighbourhood of the Donets coal fields, the former having been founded in 1873 and the latter in 1877. The Dombrovsk Mining School was opened in 1889 in the centre of the Polish mining district, that is, in the village of Dombrov. All these schools have the object of preparing the under-staff of mines and works. The Lesichansk and Poliakov's schools are exclusively mining schools, while the others are also technical and metallurgical. The Lisichansk Overmen's School and the Ural and Dombrovsk mining schools receive a yearly government grant of 57,000 roubles. The yearly expenses of the Barnaoulsk School amount to about 23,000 roubles which falls upon His Majesty's Cabinet; Poliakov's School costs its founder about 20,000 roubles a year. In the year ending 1892 these four schools had a complement of 680 students. In conclusion it should be mentioned that the Government purposes to found a new mining shool at Irkutsk for the object of preparing mining engineers for the gold workings of Siberia.

GOLD.

The production of gold in Russia dates from the middle of the eighteenth century, when deposits of this metal were almost simultaneously discovered in the Urals and in the government of Archangel. In the Urals gold was quite accidentally discovered in 1744 on the spot where the Beresovsk gold mines were subsequently situated, near the town of Ekaterinburg. These mines began working in 1748. Only ten years after their opening the production of these mines attained one poud of metal per year, while during the years 1803 to 1810 they gave as much as twenty-two pouds per year. From 1814 however the output began to decrease gradually, owing to the impoverishment of the gold-bearing veins as the depth of working increased.

In the government of Archangel gold was first discovered in 1745 in the Kemsk district at the Voitzk copper mine where particles of gold of various sizes were found disseminated in a variagated copper ore. After being intermittently worked this mine was ultimately closed in 1794, after giving a total output of three pouds and thirty-two and three-fourths pounds of gold. At the same time as the discoveries in the Urals and government of Archangel, gold was also obtained, in 1745, from the silver smelted from the ores of the Smeinogorsk mine in the Altai. In 1812 the gold industry and especially the exploitation of gold-vein deposits, was opened to all Russian subjects. Private individuals were only allowed to work gold-bearing sands in 1819.

The first discovery of alluvial gold was made in 1814 at the above-mentioned Beresovsk mines. In Siberia alluvial gold was first discovered in 1829 on the eastern side of the Alataou mountains, dividing the systems of the Yenisei and Tomi. In 1840 and 1841 rich alluvial deposits were found both in the southern and northern systems of Yenisei district. The richness of these deposits is clearly shown by the fact that in 1847 the Yenisei district alone gave more than 1,200 pouds of gold. From this time the discovery of alluvial gold gradually extended over Siberia and the gold mines acquired more and more localities, extending further and further east and at last reaching to the most eastern limits of Siberia. *

The general character of the Russian gold deposits is as follows:

1. In the Orenburg region small gold workings mainly predominate, and the greater part of them are worked by small parties of miners. The deposits have neither the thickness nor the considerable extension which distinguishes the Siberian deposits. The majority of them are not situated in the valleys of rivers, but on plains, on the summits or declivities of mountains, forming separate independent but small and irregular beds, of gold. An exception is presented at the Miassk workings where at the present time a considerable industry has been established.

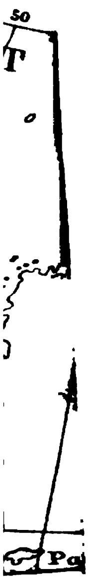
2. The deposits of the government of Perm are also distinguished for their poorness and variableness, and are of inconsiderable size. Those of the Bogoslovsk region are the least variable in their production. The deposits here sometimes extend over several versts and somewhat recall those of eastern Siberia.

3. The deposits of the Altai mountains differ sharply in their internal character from the alluvial beds deposited from the Sayansk and Yablonov mountains of Eastern Siberia along the river systems of the Yenisei, Lena and Amour with their tributaries. The Altai deposits are not rich, are narrow in their extension, not thick and have an unequal and faulty stratification. Those of the Tomsk district are particularly poor. Those of the Achinsk and Minousinsk districts are richer than those of the Tomsk, but still are poor. In general the gold deposits of western Siberia are poor and it is not rare to find workings where it is impossible to place more than ten or fifteen men, and that without horses.

4. The gold workings of the Yenisei which were formerly distinguished for their considerable richness, continuity and unvariableness have, with the working out of the richer deposits, gradually changed their character and become of a kind necessitating their being worked by small enterprises. In general this kind of exploitation is becoming more and more frequent in this district.

5. The deposits of the Nerchinsk district, Amour region and Yakutsk province, are distinguished for their richness, continuity and considerable extension, In these parts large enterprises predominate and there are all the conditions for their success. In the Vitimks and Alekminsk regions some of the deposits are exploited by underground workings. In general the richness of the gold deposits of the rivers Lena, Amour and their tributaries, shows itself in every respect, beginning with their width, size of stratification and the amount of gold they contain. Instead of five to seven sagenes which form the width of the poorer systems, the deposits of eastern Siberia are a hundred to two hundred sagenes wide and more. They are four to six feet thick and are very

* See the accompanying map of the gold and silver-bearing districts.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uniform in their formation, without any faults. The average contents of gold in the sands are from two to three zolotniks and frequently more, while the poorer deposits of other districts do not contain more than twenty to thirty dolia. Thus the yearly production of gold from the workings of such deposits attains fifty to a hundred pouds, a figure which is impossible for the poorer districts. It is exident that the modus of working the richer and poorer deposits must vary considerably.

There exist data for the production of gold beginning with the year 1814. During the first two years thirty pouds and twelve and one-half pounds of gold were produced. The following table reviews the further production. In this table the production of gold is grouped in periods of five years and the mean yearly amount is given.

Years.	Production of gold.		Average yearly production.		Years.	Production of gold.		Average yearly production.	
	Pouds.	Pounds.	Pouds.	Pounds.		Pouds.	Pounds.	Pouds.	Pounds.
1816—1820	84	19·25	16	36	1856—1860*	8,129	37·75	1,625	39·5
1821—1825	630	17	126	8·4	1861—1865	7,350	17·25	1,470	3·5
1826—1830	1,476	10·25	295	10	1866—1870	9,211	39	1,842	15·8
1831—1835	2,032	30	406	22	1871—1875	10,758	1·2	2,151	22·2
1836—1840	2,295	22	459	4·4	1876—1880	12,401	33	2,480	14·6
1841—1845	5,384	1	1,076	32·2	1881—1885	10,827	25·25	2,165	21
1846—1850	8,094	19	1,618	35·8	1886—1890	10,994	38	2,198	39·6
1851—1855	7,550	10	1,510	2					

Altogether from 1814 to 1890 inclusive there were produced 97,253 pouds of gold, not counting that which was obtained from silver. It will be seen from the above table that up to 1850 the production of gold steadily increased, while during the subsequent thirty years the output was subject to various fluctuations. A maximum was reached in 1880 when the production was 2,641 pouds and 28·75 pounds. During the last decade, after falling to 2015·5 pouds in 1885, the production has again revived and is slowly increasing from year to year. The following table gives the participation of the different regions in the general production:

Years.	Urals.	W. Siberia.	E. Siberia.
	Per cent.		
1861—1865 . . .	21·3	4·6	74·1
1866—1870 . . .	21·7	6·1	72·2
1871—1875 . . .	17·2	7·2	75·5
1876—1880 . . .	20·0	6·0	74·0
1881—1885 . . .	22·6	6·1	71·2
1886—1890 . . .	28·7	7·0	64·2

A more detailed review of the production of gold during the last ten years is given in the next table. These figures represent the amount of gold dust as received from the gold washers. They give an idea of the relative importance of the different gold-producing regions during recent years, but they do not permit of making deductions res-

* Until 1860 are given the product of alloy gold, and since that date the official figures include only schlich gold.

pecting the impoverishment or exhaustion of any of the districts. To do this it is necessary on the one hand to review the position of the gold industry for a longer period of time, and on the other hand, to subject less extensive areas, in which the general character of the deposits and conditions of their working are more uniform, to a separate investigation.

Years.	Urals.		W. Siberia.		E. Siberia.		Finland.		Total yield of gold.	
	Pouds.	Lbs.	Pouds.	Lbs.	Pouds.	Lbs.	Pouds.	Lbs.	Pouds.	Lbs.
1881	486	38¼	135	16¼	1,620	21½	1	9¼	2,244	5¼
1882	456	22	126	30¼	1,622	31	1	6¾	2,207	10
1883	493	11½	134	6	1,554	12	—	24¾	2,182	14½
1884	486	17	131	7	1,561	25½	—	—	2,178	12¾
1885	530	38	134	36¾	1,349	13	—	15	2,015	22¾
1886	560	8	136	22¾	1,345	1	—	11¾	2,042	4
1887	649	30¼	149	28	1,328	6½	—	16½	2,128	2¼
1888	665	26	154	6¼	1,326	1¾	—	33	2,146	27
1889	641	15½	169	19¼	1,462	9¼	1	15¾	2,274	19¾
1890	642	21½	160	39¾	1,599	—¼	1	3½	2,403	25

Without entering upon this subject more fully, it may be pointed out that a greater or less yield of gold in individual districts and in different years, is dependent upon such a mass of most varied facts, as is rarely met with in any other branch of industry. In the first place the gold industry is considerably influenced by legislative measures and their frequent modifications, and especially by the collection of dues upon the yield of gold, and to this fact may be ascribed some of the most decisive fluctuations in the production of this metal. On the other hand the various forces of nature play an exceedingly important part in the gold industry. The most essential element in the extraction of nearly the entire production of gold by the washing of gold-bearing sands, is water. A dry summer and a scarcity of water are very injurious, while an excessive amount of water, especially if it appears suddenly, frequently bursts the reservoirs and sluices and produces a perfect drought. It often happens that in course of one summer there is a scarcity of water followed by too great an abundance. But the injury produced by a dry, hot summer with its scarcity of water, is compensated by its utility in thawing the peat soil which covers the gold-bearing deposits, for in those localities where the gold industry is most developed, the entire soil is frozen, and it is necessary to thaw it before the gold-bearing sand can be washed. Besides these meteorological phenomena having a direct influence on the operations of the gold workings, the price of bread also has a most important effect, and which at the gold workings is entirely dependent upon the harvest of the preceding years and determines the cost of labour, which in some localities reaches 900 to 1,400 roubles per man for a working year, and which sometimes only covers four or five months.

But one of the most, if not the most important factor in the yield of gold, is the exchange value of the paper rouble. As by law the gold mine owners are obliged to hand over all the gold extracted by them to the Government which returns it to them in the form of gold coin. As all their accounts are estimated in paper roubles, it is clear that a very important part must be played by the relative values of the metallic and

the paper rouble. The lower the exchange the more desirable is it to extract the greatest possible amount of gold and it often happens that the gold-mine owners make their profits on the exchange alone. Moreover this, the most important factor in the gold industry, cannot be in any way foretold and therefore strongly reflects itself upon the yield of metal. It will be readily understood from this enumeration of the most important factors influencing the gold industry, that a series of bare figures giving the production might lead to an entirely erroneous conclusion.

The total yield of gold in Russia includes comparatively only a very small quantity of gold extracted from auriferous rock. Since 1882, however, the amount produced from auriferous veins has gradually risen as is seen from the following table:

Years.	Yield of veinous gold.					
	Urals.		Siberia.		Total.	
	Pouds.	Lbs.	Pouds.	Lbs.	Pouds.	Lbs.
1882	60	20¼	9	24½	70	4¾
1883	77	14½	9	20¾	86	35¼
1884	71	11¼	19	38¼	91	9½
1885	91	8	18	36½	110	4½
1886	101	9¼	33	15½	134	24¾
1887	130	13	33	13	163	26
1888	148	22½	23	18¾	172	1¼
1889	146	16¾	25	29¼	172	6
1890	153	4¾	23	36¾	177	1½

The above table shows that the extraction of veinous gold progresses much more rapidly in the Urals than in Siberia, where the working of auriferous veins is carried on in both portions of the Yenisei district and in the district of Nerchinsk. It is interesting to follow the total number of gold workings under exploitation and the amount of sand and quartz washed by them during the last ten years.

Years.	Urals.		W. Siberia.		E. Siberia.		Total.	
	№ of workings.	Sand and quartz washed, in pouds.	№ of workings.	Sand and quartz washed, in pouds.	№ of workings.	Sand and quarts washed, in pouds.	№ of workings.	Sand and quartz washed, in pouds.
1881	643	324,972,000	147	141,917,000	516	710,756,000	1,306	1,177,645,000
1882	455	307,062,000	159	155,424,000	487	663,386,000	1,101	1,125,871,000
1883	513	319,452,000	165	151,516,000	501	695,132,000	1,179	1,166,100,000
1884	613	347,450,000	189	153,466,000	504	699,158,000	1,306	1,200,075,000
1885	616	381,711,000	209	147,203,000	534	635,179,000	1,362	1,164,093,000
1886	689	444,176,000	215	151,216,000	541	643,469,000	1,445	1,238,961,000
1887	652	515,563,000	248	176,659,000	580	656,869,000	1,680	1,349,091,000
1888	952	538,255,000	252	179,315,000	585	630,868,000	1,789	1,348,438,000
1889	912	516,075,000	262	194,187,000	690	652,993,000	1,804	1,363,255,000
1890	797	471,691,000	248	184,496,000	671	735,259,000	1,716	1,385,447,000

The amount of sand washed is in intimate relation to the number of labourers occupied in the mines. The following table gives the number of men employed in the gold mines of different districts.

Years.	Number of men employed.			
	Urals.	W. Siberia.	E. Siberia.	Total.
1881	35,741	6,400	39,681	82,102
1882	31,651	6,653	26,768	65,072
1883	40,241	7,148	26,252	73,641
1884	40,930	8,094	27,441	76,465
1885	39,594	8,624	27,442	75,312
1886	38,794	9,158	25,593	73,546
1887	46,339	11,616	23,203	82,158
1888	47,842	11,460	24,803	84,105
1889	47,066	10,585	26,697	84,348
1890	44,086	9,512	28,242	81,840

The private gold-mine owner is obliged to forward all the gold extracted by him to the nearest State smelting houses; the gold is sent by him in the form of dust. There are three such smelting houses in the Russian Empire, one at Ekaterinburg for the Ural district, one at Tomsk for western Siberia, and one at Irkutsk for eastern Siberia. Besides which His Majesty's Cabinet under whose direction are the works of the Altai and Nerchinsk districts, has its own laboratories and smelting houses, where the unrefined gold is smelted and assays taken for determining the amount of chemically pure gold it contains. Besides gold dust these laboratories also treat the silver smelted in the Empire and separate the gold it contains.

The following table gives the amounts of chemically pure gold extracted during recent years from unrefined gold and from silver:

Years.	From gold dust.				From silver.				Total.			
	Pouds.	Lbs.	Zolotniks.	dollies.	Pouds.	Lbs.	Zolotniks.	dollies.	Pouds.	Lbs.	Zolotniks.	dollies.
1883	1,838	17	42	55	9	26	57	94	1,848	4	4	52
1884	1,864	26	17	52	14	4	63	7	1,878	30	80	59
1885	1,704	1	3	77	13	30	53	62	1,717	31	57	43
1886	1,702	37	1	14	17	—	17	74	1,719	37	18	88
1887	1,881	13	95	80	16	20	52	21	1,897	34	52	5
1888	1,907	11	55	12	15	9	53	53	1,922	21	12	75
1889	2,007	27	2	25	14	36	38	6	2,022	23	40	31
1890	2,140	11	--	47	15	15	62	28	2,155	26	62	75

The legislative measures introduced by the Russian Government for the private gold industry, have been frequently modified as the development of the industry has progressed. Up to the commencement of the present century the exploitation of gold formed a Government monopoly. In 1812 private individuals were first allowed to prospect for gold in the Urals on their own property. In 1826 Count Kankrine, the Minister of

Finance, asked the Emperor Nicholas I to grant certain private individuals special privileges for prospecting for gold on the Crown lands of the governments of Viatka and Tobolsk. Similar privileges were afterwards granted to various individuals throughout the whole of Siberia so that in 1838 when the first private gold-mining statute was edited, there were already as many as two hundred persons occupied in the gold industry. Owing to the progress made in the gold industry the statute of 1838 was revised in 1851. And lastly in 1870 new regulations for the private gold industry were published. In these regulations the previously existing diverse rules for different localities were changed for a general regulation act for the gold mines of the whole Empire. During the last twenty-two years some essential modifications have been also made in this act.

The chief conditions governing the exploitation of gold are now as follows: in granting the landowners or persons nominated by him perfect freedom in the prospecting and exploitation of gold-bearing sands and ores, and requiring only that the exploitation should be carried on without injury to the health, or danger to the lives of the workmen, the law demands the payment of a definite tribute to the State upon the gold extracted and the fulfillment of certain formalities in the exploitation of gold on State lands, and the properties appertaining to His Majesty's Cabinet. These gold-bearing deposits and veins on the State lands and the properties appertaining to His Majesty's Cabinet are let to private individuals for their temporaly exploitation until they become exhausted; that is to say, the gold-bearing deposit is regarded as movable property. The exploitation of gold is permitted to all persons possessing civil rights, both Russians and foreigners, with the exception ot Jews. All persons desirous of working gold deposits or veins are obliged to obtain a permissary certificate from the mining administration. Any locality which is not under exploitation, and which has not been previously claimed, is free for prospecting, and the gold deposits on it may be occupied under preliminary surveys over an area of not more than five versts along the direction of the valley or stream, and over the whole breadth of the same.

In the case of gold-bearing veins the area is limited to one verst radius from the gold miner's claim, marked by a post. Should the gold miner ultimately wish to exploit the claim, he is obliged to make a declaration of the gold deposit, or vein, before the police direction of the district in which it is situated. This declaration gives the right of legally acquiring the claim. To each working there is allotted a locality designated in the declaration. This allotment extends from a definite starting point, and always in the opposite direction to the current of the stream. For ore deposits the area of the allotment is limited to one square verst the width not being less than one-third of the length, while for alluvial deposits the working area must not exceed five versts and in European Russia the whole area must not exceed one square verst. The methods of working are left to the judgment of the gold miner, but the extraction of gold both in open and underground workings must be conducted without injury to the health or danger to the lives of the workmen.

There are special rules regulating the use of water on the gold workings and its consumption on neighbouring enterprises. The gold miner extracting gold on private lands pays a tributè to the Government on the yield of metal, while those working on State lands or on property belonging to His Majesty's Cabinet also pay a rental for the locality occupied by them. The tribute on the yield of gold is levied on the amount of pure gold and silver contained in the unrefined metal. In the Olekmin district, as

the richest, the tax amounts to ten per cent, a rental of ten ronbles per dessiatine for the workings on State lands; in the provinces of the Amour the tax is five per cent, and the rental five roubles per dessiatine, while in the remaining parts of Siberia and in European Russia the tax is three per cent, and the rental one rouble per dessiatine.

The gold workings on the lands appertaining to His Majesty's Cabinet are divided into three categories according to their richness, and pay a tribute to the Cabinet to the extent of from five to fifteen per cent, and a rental of fifteen kopecks per sagene on the length of the workings. Besides this the gold miner has to pay the expense of transporting the gold from the State smelting house at Ekaterinburg, Tomsk, or Irkutsk to the Imperial Mint at St. Petersburg, and the cost of converting the gold into coin. The gold and silver having been smelted and assayed, the proprietor receives bills of credit for the amount of pure metal supplied by him. These bills of credit are payable in gold and silver coin or in ingots, and may be used as a means of exchange between private individuals and banks, and are accepted in payment at the customhouse. Besides which the Siberian gold mine owners are able to obtain advances on their gold dust at the Tomsk, Yenesei and Irkutsk branches of the State Bank, to the amount of two roubles per zolotnik. This is a great help to the gold-mine owners who are frequently in want of capital.

In concluding this short review of the legislation of the private gold industry, it is necessary to add that the Government, recognizing the great importance of the treatment of gold-bearing ores, tailings and residues by chemical processes, has recently permitted the construction of such works on the basis of the special rules regulating the treatment of the tailings and washings of gold workings.

Platinum.

Platinum occurs in the Urals in the government of Perm * where it is found on various private properties and state lands. In the mining district of Goroblagodat there are seventy allotments for the exploitation of platinum under different private individuals. The platinum occurs in the form of alluvial deposits or platinum-bearing sands, which frequently also contain gold. These deposits vary in richness, from several doley to four or five zolotniks and more in a hundred pouds of sand. The thickness of the platinum-bearing deposits is rarely less than three, and sometimes reaches seven feet. The grains of platinum are small in size, but sometimes small nuggets are found weighing one or more kilograms. The platinum is often accompanied by other rare metals such as iridium and osmium. The Ural platinum deposits are the only ones in the world, as platinum is worked nowhere else, and is only known as a mineral finely disseminated in certain rocks. At the present time all the platinum extracted in the Urals is forwarded in the crude state to St. Petersburg whence it is sent abroad. Although there are two laboratories in St. Petersburg for refining platinum ore, still the greater quantity is sent abroad in the crude state. The production of platinum is subject to a tax of three per cent for leasehold, and four per cent for freehold works. The yearly revenue thus brought to the Government equals from sixty to eighty thousand credit roubles.

The rapid and variable fluctuations in the price of a product having no definitely fixed exchange value, but indispensable to the arts, reflects itself upon the production

* See map of the districts of production of precious metals.

of platinum in Russia. Thus when the price of the metal is high it becomes profitable to work the poorer deposits, while it is only possible to work the very richest when the price is low.

Although the first deposits of platinum in Russia were discovered in 1819, still the actual exploitation of this metal began only in 1824 when rich veins were discovered in the Nizhni-Tagilsk district of Demidov's works.

From 1828 to 1845 platinum money was coined in Russia. The denomination of these coins was three, six and twelve roubles; the total value of the platinum money put into circulation was 4,250,000 roubles. During this period the production of platinum increased considerably, but when platinum coinage was stopped the exploitation of the metal almost entirely ceased and only revived in 1859. From that time the production has varied with the foreign demand and market price. The production of platinum began in 1824 with 2 pouds 1 pound; in 1825 it increased to 11 pouds 24·5 pounds, and it subsequently varied in the manner shown in the following table, in which the data are given for periods of five years.

	Production.		Average yearly production.			Production.		Average yearly production.	
	Pouds.	Lbs.	Pouds.	Lbs.		Pouds.	Lbs.	Pouds.	Lbs.
1826—1830	319	$26\frac{1}{4}$	63	$37\frac{1}{4}$	1861—1865	441	18	88	$11\frac{3}{5}$
1831—1835	550	34	110	$6\frac{4}{5}$	1866—1870	599	$34\frac{1}{4}$	119	$38\frac{4}{5}$
1836—1840	452	$7\frac{1}{2}$	90	$17\frac{1}{2}$	1871—1875	531	$23\frac{1}{4}$	106	$12\frac{1}{5}$
1841—1845	590	$27\frac{1}{4}$	118	$5\frac{1}{2}$	1876—1880	646	4	129	$8\frac{4}{5}$
1846—1850	23	$17\frac{3}{4}$	4	$27\frac{1}{2}$	1881—1885	942	6	188	$17\frac{1}{5}$
1851—1855	91	12	18	$10\frac{2}{5}$	1886—1890	1033	6	206	$25\frac{1}{5}$
1856—1860	136	33	27	$14\frac{3}{5}$					

Thus the total production of crude platinum in Russia from 1824 to 1890 inclusive was 6,373 pouds. In giving in the following table the number of platinum deposits under exploitation during recent years, together with the quantity of sand washed and the production of metal, it should be noted that a portion of the platinum was obtained as a by-product from gold.

Year.	Number of working deposits.	Sand-washed.	Production of metal.	
		Pouds.	Pouds.	Lbs.
1881	66	15,036,900	182	$10\frac{1}{4}$
1882	82	20,127,800	249	12
1883	107	11,194,000	215	33
1884	71	19,502,000	136	25
1885	58	17,388,400	158	$8\frac{1}{2}$
1886	83	23,036,100	263	$21\frac{3}{4}$
1887	93	61,773,300 *	269	4
1888	75	58,856,700	165	$35\frac{1}{4}$
1889	72	67,184,800	160	$36\frac{1}{2}$
1890	82	47,334,100	173	$26\frac{3}{4}$

* Previous to 1887 there were no official returns of the amount of sand washed; up to that date the platinum-bearing was given together with the gold-bearing sand.

The largest quantity of platinum is now extracted at the deposits of Nizhni-Tagilsk belonging to Prince Demidov San Donato, and at the Krestovozdvighensk deposits of Count Shuvalov. In 1890 there were 5,853 men actually employed in the exploitation of platinum. The export of platinum is given in the following table:

Year.	Germany.	Great Britain.	Austria.	Total.
	P o u d s.			
1884 . . .	103	28	—	131
1885 . . .	28	261	1	290
1886 . . .	52	237	—	289
1887 . . .	50	263	—	313
1888 . . .	51	178	—	229
1889 . . .	34	216	—	250
1890 . . .	13	194	—	207

The value of the yearly export of platinum from Russia amounts to from 1,000,000 to 1,560,000 roubles.

SILVER.

Although the first discovery of silver ores in the district of Nerchinsk in eastern Siberia was made in the beginning of the second half of the seventeenth century, still the actual smelting of silver was not begun before 1704. And veins of silver ore were discovered at Smiainogorsk in the Altai by Akinfi Demidov in 1735, but it was only after ten years, in 1745, when they were taken over by the Government, that the smelting of the ores was begun. The production of silver at the Nerchinsk works attained a maximum during the seventies of the last century, when it amounted to 600 pouds; during the same period the production of the Altai works exceeded 1,100 pouds, so that at that time the works of these two districts produced as much as 1,700 pouds of silver. The following data show how much the production of silver has varied since the beginning of the present century.

	Production.		Average yearly production.			Production.		Average yearly production.	
	Pouds.	Lbs.	Pouds.	Lbs.		Pouds.	Lbs.	Pouds.	Lbs.
1822—1825	4,540	—	1,135	—	1856—1860	5,306	2	1,061	$8^2/_5$
1826—1830	5,780	—	1,156	—	1861—1865	5,259	31	1,051	$38^1/_5$
1831—1835	6,361	8	1,272	$9^3/_5$	1866—1870	4,972	$17^3/_4$	994	$19^1/_2$
1836—1840	6,053	6	1,210	$25^1/_5$	1871—1875	3,509	—	701	32
1841—1845	5,980	33	1,198	$6^3/_5$	1876—1880	3,378	2	675	$24^2/_5$
1846—1850	5,690	32	1,138	$6^2/_5$	1881—1885	2,731	1	546	$8^1/_5$
1851—1855	5,236	33	1,047	$15^4/_5$	1886—1890	4,408	$30^1/_4$	881	30

During the present century the production of silver was greatest in 1831, but even then it was only 1,318 pouds or not more than 76 per cent of the yield at the close of the last century. The following table shows the yield of silver for the different silver-bearing districts during the last ten years *.

* See map of the districts of precious metals.

Year.	Caucasus.		Altai.		Kirghis steppes.		Nerchinsk.		Urals.		Finland.		Total.	
	Pouds.	Lbs.	Pouds.	Lbs.	Pouds	Lbs.	Pouds.	Lbs.	Pouds.	Lbs.	Pouds.	Lbs.	Pouds.	Lbs.
1881	29	32¼	463	4½	—	—	54	39	28	4¼	—	—	576	—
1882	35	14	397	25¼	—	—	49	37¾	6	32	—	—	489	29
1883	30	15½	368	12¼	—	32¼	50	20½	—	13	—	—	450	13¼
1884	29	27	446	29¼	—	—	51	6¾	—	—	—	—	527	23¼
1885	33	36¾	535	28½	35	2¼	52	13	—	—	30	20	687	15½
1886	30	30½	613	6¾	84	28½	52	39½	—	—	28	30	810	10¼
1887	32	17¼	661	38	171	16¼	51	25	—	—	21	17¾	938	34¼
1888	29	8¼	682	4½	136	8	50	30	—	—	25	35½	924	6¼
1889	33	32	652	1¾	110	10½	50	4	—	—	—	—	846	8¼
1890	30	24½	681	8	72	28½	54	34¼	—	—	49	36	889	11¼

The Altai mining district of His Majesty's Cabinet continues to supply more than three-fourths of the entire production of silver in Russia. In 1860 the Altai district yielded 1,060 pouds; but twenty-five years later the production fell to less than a quarter of that amount, that is, only 446·75 pouds were smelted in 1884; since then the production has revived and has gone up to 681 pouds. In the Nerchinsk mining district of His Majesty's Cabinet, where up to 1863 the production of silver did not exceed 7·5 pouds, the yield has steadily risen since 1866, and in 1881 it attained 55 pouds at which figure it also stands in 1890. In the Caucasus there is a single silver smelting establishment, the Alagirsk works, belonging to the State. The annual production of these works varies between twenty-nine and thirty-five pouds. The works of the Kirghis steppes are very primitive and their production varies considerably. In the Urals, where silver was first smelted in 1874, the production reached a maximum of 28 pouds, 35 pounds in 1880, but it subsequently fell rapidly and ceased entirely in 1884. Lastly in Finland there is also one establishment, the Pitkarand works on the northern shores of Lake Ladoga which has recently given from 22 to 50 pouds of silver yearly.

All the silver smelted in Russia is extracted from argentiferous lead ores; but besides this all the gold produced in Russia contains silver, whose amount is determined by assays taken at the state smelting houses.

Although the amount of chemically pure silver contained in the crude silver ingots can only be determined by assays taken at the smelting works, and the necessary data for this are wanting for certain years, still the following table gives the minimum amount of chemically pure silver contained in the silver ingots and gold produced in Russia during the last eight years.

Year.	In silver ingots.		In unrefined gold ingots.		Total.	
	Pouds.	Lbs.	Pouds.	Lbs.	Pouds.	Lbs.
1883	411	39	179	31	591	30
1884	527	23	229	10	756	33
1885	537	8	146	9	683	17
1886	762	24	151	7½	913	31½
1887	876	31½	166	7½	1,042	39
1888	823	22	171	—	994	22
1889	773	—	179	8	952	8
1890	826	13	185	25¾	1,011	28¾

The silver smelted by private individuals is subject to a tax which was lowered in 1887 from ten and fifteen per cent to three per cent for freehold, and four and a half per cent for leasehold works. It may not be superfluous to supplement the above remarks upon the production of precious metals in Russia, by a table giving the amount of money coined in the Empire during the last ten years.

Year.	Roubles.			
	Gold.	Silver bank money.	Silver exchange money.	Copper.
1881	22,735,072	435,021	1,112,516	648,951
1882	27,187,040	504,854	1,500,003	481,150
1883	25,119,054	556,311	1,000,004	299,852
1884	26,802,088	425,519	1,000,006	100,000
1885	18,126,210	564,091	1,200,053	100,000
1886	27,055,175	510,551	1,000,002	100,000
1887	25,510,095	500,022	1,000,011	100,000
1888	24,430,030	1,753	2,000,001	100,000
1889	28,150,090	76,760	2,000,003	200,000
1890	3,735,140	500,024	2,351,504	200,000 1/2

Besides which the following table gives the import and export of gold and silver during the last four years.

	1887.	1888.	1889.	1890.
	Roubles.			
Import.				
Gold in ingots, pouds	23·8	350·4	32·5	59
» » » value	373,968	5,494,272	455,726	822,621
» coins, pouds	127·6	1,089·4	176·6	1,185
» » value	1,817,124	15,513,412	2,231,908	14,978,084
Silver in ingots, pouds	3,362	10,842	10,662	9,073
» » » value	2,955,106	9,541.268	7,484,461	6,368,912
» coins, pouds	1,120	1,705	1,569	1,595
» » value	896,300	1,364,360	990,561	1,008,372
Export.				
Gold in ingots, pouds	214	1,403	0·4	—
» » » value	3,356,696	22,000,216	5,616	—
» coins, pouds	1,090·8	913	1,380·2	1,318
» » value	15,533,424	13,001,120	17,445,412	16,915,164
Silver in ingots, pouds	2,789	4,169	3,671	2,448
» » » value	2,453,924	3,668,940	2,576,709	1,718,777
» coins, pouds	553	478	706	3,629
» » value	442,280	382,420	446,097	2,293,528

COPPER.

The production of copper in the Urals dates from the middle of the seventeenth century, copper smelting was also begun in the Altai by Akinfi Demidov at the commencement of the eighteenth century. At the close of the last century the private copper works of the Urals alone smelted as much as 100,000 pouds of copper, while in 1816 the production of these works rose to 178,400 pouds, so that at that time the total yield of copper in Russia amounted to at least 200,000 pouds.

Starting from 1822 the production of copper in Russia was as follows.

	Quantity of copper smelted.	Average yearly production.		Quantity of copper smelted.	Aver ge yearly production.
	Pouds.	Pouds.		Pouds.	Pouds.
1822—1825	774,666	193,666	1861—1865	1,412,758	282,552
1826—1830	1,115,945	223,189	1866—1870	1,364,538	272,907
1831—1835	1,134,310	226,862	1871—1875	1,148,514	229,703
1846—1850*	1,556,314	311,263	1876—1880	1,051,450	210,290
1851—1855	1,864,827	372,965	1881—1885	1,364,629	272,926
1856—1860	1,676,456	335,291	1886—1890	1,507,174	301,435

Up to 1845 the average yield of copper in Russia amounted to from 200 to 250 thousand pouds yearly, but during the following seven years this figure rapidly rose, and in 1852 the production already amounted to over 410,000 pouds. In the last century Russia supplied the whole of Europe with copper and up to the middle of the present, was one of the chief sources from which the European markets obtained their copper; the famous bronze industry of France was mainly dependent upon Russia for its metal. This period also corresponds to the fortifying of Paris and to the reinforcement of the French artillery previous to the Crimean war. The Russian copper-smelting works attracted so much interest on the part of French Government that they requested the Russian consul at Paris to inform them of the various trade marks of the Russian works, and advised the alteration of several marks which were likely to be counterfeited. The increased export of copper from Russia at this time raised the price and gave the possibility of increasing the production of the Russian copper-smelting works. But since 1852 the yield of copper in Russia has gradually fallen.

The liberation of the serfs in 1861 and the policy of the customs of 1857 to 1876 almost ruined the copper industry. At that time the Russian copper masters paid a tax of from one to one and a half roubles per poud, while the duty upon foreign copper was only sixty kopecks per poud. Under these conditions the production of copper decreased more and more, and in 1879 it was only 190,688 pouds or less than half of that for 1852. It was only in 1884 when half the copper works were already closed, that the duty upon foreign copper was raised to 1·50 roubles gold. But even this duty proved insufficiently protective. owing to the appearance of a new universal crisis in the copper industry, brought on by the larger development of the production of copper in the New World and the consequent fall in the price of the metal on all the

* Full data are wanting for the years from 1836 to 1845.

European markets. In order to sustain the copper industry which supports a large population in the distant parts of the Ural, Altai, Caucasus and Kirghis steppes, the duty was raised in 1886 to 2·50 roubles per poud. Since the yield of copper has again increased, and during the last ten years the production in Russia has varied as follows.

Year.	Urals.	Kirghis steppes.	Altai.	Finland.	Siberia.	Caucasus.	Total.
		P	o	u	d	s.	
1881	126,083	18,578	21,500	7,262	491	37,551	211,465
1882	128,934	19,100	16,800	5,908	—	48,538	219,280
1883	165,762	22,214	14,015	9,396	—	54,552	265,939
1884	221,985	34,500	24,000	11,658	—	87,544	379,687
1885	146,701	23,933	24,605	11,405	—	81,619	288,258
1886	149,742	4,038	17,800	13,110	—	94,366	279,056
1887	163,045	249	16,240	12,218	—	112,855	304,607
1888	156,777	308	18,200	12,345	—	93,385	281,015
1889	157,949	345	21,073	23,070	—	90,539	292,976
1890	173,307	—	19,337	17,544	—	139,332	349,520

During these ten years the production showed an increase of 138,000 pouds, or more than fifty per cent. This increase was, to a considerable extent, due to the development of the copper works in the Urals, and even more, to the rapid growth of the copper industry of the Caucasus which may be ascribed to the richness of the deposits, and to the technical perfection of certain works.

The largest output is given by the Bogoslov copper works in the Ural and the Kedabek works in the Caucasus. The former is notable from the fact that the copper ores are treated by the wet method and the copper deposited by electricity; they also refine the coarse metal in Bessemer convertors. At the Kedabek works they use naphtha refuse for fuel in the smelting furnaces. In the Kirghis steppes, renowned for the great richness of their deposits, the copper industry has entirely fallen, chiefly owing to the want of fuel. In the Altai the production of copper varies very slightly from year to year. In Finland however copper mining has recently increased to a marked degree. The general decrease in the yield of copper is not due to the exhaustion of the deposits, as copper ores are found in many parts of Russia.

In the Ural some works smelt the ores from veins and lodes, while others treat the ores of aqueous origin. The copper ores of the former category are situated on the eastern declivity of the Ural and they are all distinguished for the small amount of copper they contain, from three to seven per cent. These ores are chiefly pyritic, copper pyrites, copper glance, fahlerz, besides which azurite, malachite, red copper ore and native copper are met with. The works situated on the western declivity of the Urals smelt ores which occur in many localities in the form of masses disseminated in strata of the Permian system which are widely spread throughout the governments of Perm, Viatka, Kazan, Orenburg, Ufa and Samara. These ores are still poorer than the first, and only contain from two to three per cent of copper; they include azurite, emerald

copper, more rarely malachite, red and brown copper ore, and very rarely native copper. In the Caucasus the copper ores occur in veins which are widely distributed throughout the southern side of the mountain chain. These ores are chiefly sulphurous and are distinguished for their richness, which attains seven to fifteen per cent of copper. The deposits of the Kirghis steppes are the most favourable, both in respect to their size and richness. In this district there are vast deposits which frequently contain considerable masses of native copper, while the ores contain 25 to 33 per cent of metallic copper.

In 1890 there were 109 copper mines under exploitation, having a total output of 8,243.483 pouds of ore, the output of the previous year being 8,662,042 pouds, and locally distributed as follows:

	1889.	1890.
	Production in pouds.	
Ural	4,815,100	4,220,700
Altai.	514,100	60,300
Khirghis steppes . .	161,300	13,300
Yenisei.	1,100	—
Caucasus	1,458,700	2,225,500
Olonets.	113,100	51,700
Finland.	1,598,600	1,672,000

Owing to the diversity in the richness and facility of working the copper ores of the Ural the Government found it necessary in 1869 to change the previously existing tax of 10 per cent upon the yield of copper from freehold works, and of 15 per cent from works leased on State lands, to fifty kopecks per poud for the copper smelted from vein deposits upon freehold works, twenty-five kopecks per poud for that extracted from the sedimentary deposits of the western side of the Urals, one rouble for vein deposits and seventy-five kopecks for the sedimentary deposits smelted by works leased on State lands. This lowered the tax upon copper approximately thirty per cent. In the Caucasus a mining tax of fifty kopecks is levied on the copper smelted by freehold works and of seventy-five kopecks per poud on that smelted by works leased on State lands. At the present time the revenue collected by the Government from the copper industry amounts to from 150 to 180 thousand paper roubles yearly.

On turning to the foreign trade and consumption of copper in Russia it is found that in 1853 about 400,000 pouds of copper, having a value of at least four million roubles, were exported, while the amount of copper imported did not then exceed 3,000 pouds. Up to the year 1866 the export of copper, although it fell to an average of fifty thousand pouds, exceeded the import, or in other words, the internal production exceeded the requirements of Russia for this metal. Since 1867 the export has diminished, while the import has gone on increasing. Thus in 1880 the importation of copper amounted to 566,000 pouds, having a value of over 6,500,000 roubles, while the export did not exceed 82,000 roubles. The export of copper during the last ten years has varied as shown in the following table.

Years.	Copper exported from Russia.		
	Ingots.	Sheets.	Total.
	Pouds.		
1881	—	—	14,000
1882	—	—	206,700
1883	—	—	35,500
1884	—	—	26,900
1885	17,900	2,300	20,200
1886	12,400	200	12,600
1887	10,150	400	10,550
1888	3,400	300	4,700
1889	4,000	500	4,500
1890	4,800	550	5,350

At the present time the chief consumers of Russian copper are Persia, which is supplied by the copper works of the Caucasus, and Germany. During the last ten years the importation of copper ingots into Russia has considerably risen, while the amount of sheet copper and of copper rods has decreased. The following table gives the imports of copper into Russia during the last ten years.

Years.	Copper ingots and scraps.	Sheet copper, copper rods and bars.	Total.
	Pouds.		
1881	—	—	537,800
1882	—	—	127,500
1883	72,000	151,000	223,000
1884	97,000	184,000	281,000
1885	109,000	87,000	196,000
1886	105,214	28,844	134,058
1887	37,057	13,732	50,789
1888	25,649	8,164	33,813
1889	219,844	22,395	242,239
1890	246,159	22,018	268,177

The following data show what countries participated in supplying Russia with copper, and to what extent.

Countries.	Copper ingots and scraps.			Sheet copper, copper rods and bars.		
	1888.	1889.	1890.	1888.	1889.	1890.
	Pouds.					
From Great Britain	2,000	117,100	136,200	600	9,900	11,200
» Germany	11,800	56,400	82,600	6,400	10,800	8,300
» Holland	300	6,250	7,500	200	—	—
» France	—	12,000	2,500	—	—	500
» Belgium	—	2,200	600	—	600	900
» Austro-Hungary	—	—	—	80	700	—
» Italy	—	—	400	—	—	—
» Turkey	—	—	—	—	260	500
» Denmark	—	1,100	—	—	—	—

According to the customs tariff of 1891 the following duties were put on copper, aluminium, nickel, cobalt, bismuth, cadmium, brass, tompak, britannia, and all alloys of the non-noble metals, beyond those specially named above:

1. In the form of pig copper, ingots, turnings, fillings and scrap, and also in copper in the form of powder, 2·50 roubles in gold per poud.

2. In the form of bars, rods and sheets, 3·10 roubles in gold per poud.

3. On copper and its alloys when rolled or drawn into wire, half an inch or less in width, or diameter, the duty is the same as for copper wire, namely:

a. On all telegraph cables from half an inch in width or diameter to № 25, inclusive of the Birmingham guage, a duty of four roubles per poud.

b. Above № 25 to № 29 inclusive, five roubles per poud.

c. Finer than № 29, six roubles per poud.

LEAD.

Lead is only obtained together with silver from argentiferous lead ores. In general the amount of lead smelted in Russia is very inconsiderable and is expressed by the following figures during the last sixty years.

Years.	Amount of lead smelted.	Average yearly production.	Years.	Amount of lead smelted.	Average yearly production.
	Pouds.			Pouds.	
1831—1835	209,696	41,939	1866—1870	476,416	95,283
1836—1840	245,492	49,098	1871—1875	387,671	77,534
1841—1845	292,180	58,436	1876—1880	382,864	76,573
1846—1850	259,794	51,959	1881—1885	210,590	42,118
1861—1865 *	357,106	71,421	1886—1890	243,144	48,629

All the lead smelted in Russia is obtained from the argentiferous lead ores of the Caucasus and Siberia. In the Caucasus the ore is mined at the Alagirsk Government Works, and in Siberia at the Altai and Nerchinsk mining districts of His Majesty's Cabinet, and also in the Kirghis steppes, where the exploitation of the lead ores is carried on by private individuals. Lead was only smelted as an independent product at one set of works in Turkestan. These works were constructed in 1881 and only kept in operation till 1885. Besides this, argentiferous lead ores are known to exist on the Mourman coast in the government of Archangel. A private company has recently been formed for working these ore deposits which were only fully surveyed in 1890. Private individuals are also endeavouring to make a detailed survey of the argentiferous lead deposits of the government of Ekaterinoslav, and to start the smelting of these metals there. The actual smelting of lead is carried on only in four districts whose production during the last ten years is shown in the following table.

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* Complete data are wanting for the production of lead during 1850 to 1860.

Years.	Altai.	Ner-chinsk.	Caucasus.	Kirghis steppes.	Total.
	Pouds.				
1881	41,670	8,927	9,620	—	60,217
1882	14,890	7,775	9,292	—	34,957*
1883	16,385	6,884	9,895	—	33,164
1884	20,083	7,369	8,455	2,693	38,600
1885	16,706	7,597	9,115	3,186	43,651**
1886	22,079	7,690	8,755	8,937	47,461
1887	31,117	8,356	9,592	11,363	60,428
1888	10,099	7,205	8,962	22,544	48,810
1889	6,653	7,896	9,929	10,836	35,314
1890	19,305	7,827	9,306	14,693	51,131

The fact that Russia produces so inconsiderable a quantity of lead clearly indicates that it is dependent upon foreign countries for its supply of a metal so indispensable. Indeed the following data show that Russia annually imports about a million pouds of lead.

Years.	Pig lead and scrap.	Lead sheets, rolls and pipes.	Total.
	Pouds.		
1883	939,000	147,000	1,086,000
1884	934,000	137,000	1,071,000
1885	398,000	125,000	523,000
1886	654,972	170,452	825,424
1887	928,516	150,289	1,078,805
1888	1,037,479	175,490	1,212,969
1889	1,010,607	191,858	1,202,465
1890	1,116,355	202,521	1,318,876

During the last three years the imports of lead have been as follows.

Countries.	Pig and scrap lead.			Sheet, roll and pipe lead.		
	1888.	1889.	1890.	1888.	1889.	1890.
	Pouds.					
From Great Britain	375,400	522,800	702,800	117,500	150,100	159,100
» Germany	476,100	289,100	229,800	28,100	21,950	25,800
» France	89,400	131,300	86,900	7,900	10,000	11,500
» Belgium	50,200	41,800	43,300	700	1,900	1,300
» Holland	10,900	14,500	28,900	—	—	—
» United States	3,100	—	9,300	—	—	3,200
» Denmark	600	—	3,000	—	—	—
» Austro-Hungary	—	1,300	1,500	2,800	400	800
» Turkey	13,600	400	—	700	700	—
» Italy	5,300	3,100	—	—	—	—

* Including 3,000 pouds smelted at the Turkestan works.
** Including 7,047 pouds smelted at the Turkestan works.

According to the customs tariff of 1891 lead imported into Russia is subject to the following duty:

1. Lead in pig and scrap, litharge, lead ash, 10 kopecks in gold per poud.
2. Lead in rolls, sheets, wire and pipes 30 kopecks in gold per poud.
3. Type metal 20 kopecks per poud in gold.

ZINC.

All the Russian zinc works are situated in Poland, although deposits of zinc ores are also known in other parts of the Empire, for instance in the Caucasus, southern Russia, on the Mourman coast of the government of Archangel, in Siberia, and also in Finland. The annexed table gives the production of zinc since 1836.

Years.	Production of zinc.	Average yearly production.	Years.	Production of zinc.	Average yearly production.
	Pouds.			Pouds.	
1836—1840	856,103	171,221	1866—1870	972,233	194,447
1841—1845	768,585	192,146	1871—1875	1,052,852	210,570
1846—1850	823,900	184,780	1876—1880	1,387,708	277,542
1851—1855	447,425	89,485	1881—1885	1,317,850	263,570
1856—1860	435,730	87,146	1886—1890	1,169,254	233,851
1861—1865	831,072	166,216			

In Poland, zinc is exclusively extracted from calamine, deposits of which are chiefly worked in the neighbourhood of Olekousha where the exploitation of argentiferous lead ores has been carried on for several centuries. These lead deposits lie in the upper portion of the strata from which the calamine is now extracted. The zinc ore here occurs in a dolomite formation and contains from eight to fifteen per cent of metallic zinc. A portion of the zinc here produced goes to the interior of Russia in the raw state and is chiefly used for the manufacture of brass, the remainder is rolled into sheets at the two existing works of Poland whose yearly production is from 150,000 to 200,000 pouds of sheet metal. There are also works for the preparation of zinc white at the same locality, and which turn out about 50,000 pouds yearly.

Since 1888 a mining tax of eight kopecks per poud has been placed upon the pig zinc manufactured in Russia. This brings in an annual revenue of 18,000 paper roubles to the Government. The amount of zinc produced in Russia is far from sufficient to supply the increasing demand, so that a considerable quantity of the metal is annually imported into Russia, as is seen from the following table.

Years.	Imports of zinc.		
	Zinc in pigs.	Zinc in sheets.	Total.
	Pouds.		
1881	99,400	42,300	141,700
1882	140,400	11,000	151,400
1883	132,600	16,000	148,600
1884	211,600	33,500	245,100
1885	173,000	9,600	182,600
1886	151,196	13,168	164,364
1887	40,244	8,373	48,617
1888	60,821	23,549	84,370
1889	186,310	57,760	244,070
1890	299,113	34,009	333,122

The importation of sheet zinc, which in 1879 amounted to 163,000 pouds, rapidly fell after the new zinc rolling works were built in 1880 in Poland. The returns of the customhouse show the exportation of zinc abroad, but a considerable portion of this zinc was re-imported into Russia, as owing to the high railway rates the Polish zinc was forwarded to St. Petersburg by sea through Stettin. The following table indicates what countries participated in furnishing Russia with zinc, and to what extent.

Countries.	Pig zinc.			Sheet zinc.		
	1888.	1889.	1890.	1888.	1889.	1890.
	Pouds.					
From Germany	45,100	166,500	254,100	16,100	48,400	28,200
» Great Britain	5,300	8,800	23,000	3,900	3,200	400
» Holland	6,150	8,250	14,200	—	—	—
» Belgium	3,400	2,800	4,000	3,450	900	2,100
» Denmark	—	900	1,900	—	—	—
» Austro-Hungary	—	1,200	1,200	—	700	400
» France	700	—	—	—	—	2,800

According to the customs tariff of 1891, zinc imported into Russia is subject to the following duties:

1. Pig zinc and scrap, 50 kopecks in gold per poud.
2. Sheet zinc, one rouble in gold per poud.

Sheet zinc coated with nickel or other metals is subject to an extra duty of thirty per cent above that put upon sheet zinc; that is, 1·30 roubles per poud.

TIN.

Deposits of tin are only known in Finland and in the Baikal province of Siberia. At the present time tin is only smelted at the Pitkaransk works in Finland, and that only in very inconsiderable quantities. The production of these works has especially fallen since the seventies, but during recent years it has again begun to rise. During the last ten years the following amounts of tin were smelted at these works:

Years.	Production of tin. Pouds.	Years.	Production of tin. Pouds.
1881	604	1886	1,038
1882	320	1887	629
1883	1,117	1888	1,186
1884	765	1889	721
1885	860	1890	804

In general the yearly demand in Russia for tin is over 100,000 pouds, so that the above internal production is utterly insufficient for home requirements. Therefore, a large quantity of tin is imported as the following figures show:

Imports of tin.

1881	126,900 pouds.	1886	106,000 pouds.
1882	89,100 »	1887	111,000 »
1883	114,300 »	1888	143,700 »
1884	111,400 »	1889	132,600 »
1885	78,700 »	1890	161,400 »

During the last three years the following countries have been the chief sources from which Russia has imported tin:

Imports of tin.

Countries.	1888.	1889.	1890.
	Pouds.		
Great Britain	100,300	91,300	92,600
Holland	22,300	21,700	34,300
Germany	15,800	15,600	17,900
France	1,300	600	14,300
Belgium	700	1,900	600

Under the customs tariff of 1891, tin imported into Russia is subject to the following duties:

1. Pig tin, rods and scrap, 45 kopecks in gold per poud.

2. Sheet tin, mirror backs, and lead sheets coated with tin, 1 rouble in gold per poud. Tin sheets and lead sheets coated with tin, and colored or covered with coloured varnish pay a duty of 1 50 roubles.

MERCURY.

Deposits of mercury ores were first discovered in Russia in 1879 in the government of Ekaterinoslav near the station of Nikitovka on the Kursk-Kharkov-Azov Railway. Mercury has also been recently discovered in the Caucasus at Daghestan but these deposits have not yet been opened out. The deposits near the station of Nikitovka lie in strata of the carboniferous system, and consist of cinnabar which fills the crevices in sandstone. The exploration of these deposits proved that they occupy an exceedingly large area. Traces of ancient workings were also brought to light, and notwithstanding that they extend over a distance of about two versts there is no record of the epoch to which they belong.

These deposits were first worked in 1885 by the present owners, A. A. Auerbach and Co., who in 1886 built small works capable of turning out about four thousand pouds of mercury annually, which corresponded to the internal consumption of Russia. But already in 1887 these works were considerably enlarged owing to the evident possibility of a considerable market being found abroad. The mines and works are models of their kind, and are better organized and work on a more economical and rational basis than those of Idria and Almaden. At the present time the locality of the works which in 1885 was a bare steppe is now occucied by a busy population of over 1,500 inhabitants. The production of these mines and works is shown in the following table.

Years.	Production of ore.	Production of metallic mercury.
	Pouds.	
1887	762,300	3,911
1888	2,005,250	10,062
1889	3,074,450	10,202
1890	3,686,680	17,835

In 1890 there were 687 men employed on the mercury mine and works. In 1892 the Russian Government seeing that the mercury industry had taken firm root, placed a mining tax of 50 kopecks per poud upon the mercury produced in the Empire. It is estimated that in 1893 this tax will bring in a revenue of 12,000 paper roubles. Up to 1886 Russia annually imported from 2,000 to 5,000 pouds of mercury having a value of from 85,000 to 200,000 roubles, but since 1887 this amount has fallen to 250 pouds. Indeed now a considerable portion of the mercury produced in Russia is sent abroad, thus in 1889, 7,805 pouds were exported, and in 1890, 13,855 pouds having a value of 642,916 roubles. This mercury goes exclusively to Germany. According to the customs tariff of 1891 mercury imported into Russia is subject to a duty of 2.40 roubles in gold per poud.

MANGANESE.

Deposits of manganese ore are known in the Caucasus, south of Russia and Urals. The exploitation of manganese ores is chiefly carried on in the Transcaucasus, where the workings are almost exclusively limited to the Sharapan district of the government of Kutais. However the production of manganese ore is also carried on to a small extent in the district of Kutais and in the government of Tiflis.

The richest deposits occur in the district of Sharapan at Chiatoura and extend over an area of about a hundred and twenty square versts, divided by the river Kvirila which with its tributaries passes through deep ravines and has laid bare the ore deposits. The deposits vary from five to seven feet in thickness and contain from six to eleven layers of manganese, about five inches thick. The exploitation of these deposits was first started in 1879. At first they were only worked by large capitalists, but they met with competition on the part of the small landowners of the district, in consequence of which the price of the ore began to fall. Owing to this circumstance the larger enterprises by degrees stopped working and at the present time the manganese industry is mainly in the hands of small capitalists who in the majority of cases do not understand mining matters, and consequently work the deposits in a most irrational manner. At first there was great difficulty in transporting the ore from the mines to the railways, about fifty versts distant, but now this difficulty has been overcome by the construction of a special branch line to the mines from the main line of the Transcaucasian Railway.* The ore worked in the district of Sharapan contains 56 per cent of metallic manganese, and in general is distinguished for its fine quality as is shown by analysis made at New Castle.

There are also deposits of manganese ore, which however contain a somewhat smaller percentage of manganese, at a short distance from the Transcaucasian Railway, and much nearer the Black Sea. These deposits are situated near the Samtredi and Novo-Senaki Railway stations.

In the Urals, manganese ores are worked in the government of Perm in the region of the Nizhni-Taghilsk works, and also in the government of Orenburg in the district of Verkhneuralsk. Deposits of manganese ores are also known to exist in the government of Ekaterinoslav near Nikopol, where they occur in beds as much as half a sagene thick on strata of the Eocene formation. These deposits were first worked in 1886, and now there are two mines from which the ore is raised. According to foreign analysis the ore of the government of Ekaterinoslav contains about 57 per cent of peroxide of manganese.

The total production of manganese ore in Russia during the last ten years is given in the following table.

Years.	Caucasus.	Ural.	Ekaterinoslav.	Total.
	Pouds.			
1881	686,100	—	—	686,100
1882	763,000	118,000	—	881,000
1883	975,000	66,000	—	1,041,000
1884	1,263,000	88,300	—	1,351,300
1885	3,640,800	54,700	—	3,695,500
1886	4,242,100	50,000	250,000	4,542,100
1887	3,277,200	50,000	226,350	3,553,550
1888	1,822,800	82,700	89,600	1,995,100
1889	4,243,200	179,100	341,500	4,763,800
1890	10,468,100	143,500	528,100	11,139,700

The greater portion of the manganese ore raised in Russia is sent abroad, and only a small quantity is smelted into ferro-manganese on the spot *. In 1890 the Ural works produced 22,000 pouds of ferro-manganese and spiegeleisen and the works of southern Russia, 617,300 pouds.

The accompanying table gives the export of Russian manganese ore during the last nine years.

Years.	Export of manganese ore.	Years.	Export of manganese ore.
1882	562,700	1887	3,690,400
1883	871,500	1888	3,042,700
1884	1,247,800	1889	3,440,300
1885	2,567,000	1890	8,129,500
1886	3,403,400		

The following table gives the amounts exported to the different countries during the last three years. It should be remarked however that the ore imported by Holland was probably destined for German works, and also, that all goods transported by sea to Gibraltar are shown as exported to Great Britain, although some vessels are registered to Gibraltar only, hence the following data cannot be regarded as absolutely correct.

Countries.	Manganese ore.		
	1888.	1889.	1890.
	Pouds.		
Great Britain	1,627,800	2,348,400	5,275,000
Holland	768,000	349,000	1,466,700
France	276,700	121,600	511,500
Germany	250,500	303,400	439,400
United States	—	9,400	400,100
Belgium.	132,000	104,700	104,800

* In 1890, 478,676 pouds of manganese ore were smelted.

Cobalt and Nickel.

Cobalt is solely produced in the Caucasus at the Dashkesan works situated in the government of Elisavetpol. Cobalt speiss was for the first time produced in Russia at the above-mentioned works in 1867 when 1,300 pouds of speiss wire were smelted. Since then the preparation of cobalt has been continued, although there have been intervals of several years when the production has ceased.

Deposits of nickel ore are known in various parts of the Urals, and also in the Caucasus in the province of Daghestan. The richest deposits of nickel ore in Russia occur in the Revdin mining district of the Urals. Still there is every possibility of similar deposits being found in other parts of the Urals. The deposits in the Revdin district were first discovered in the fifties, and the Petrovsk mine was subsequently laid out for working them. This in the only instance known in Europe of a mine working oxidized nickel ores almost free from sulphur and arsenic. The percentage of nickel varies, but may be said to average about two per cent. The first experiments of smelting nickel were made in the beginning of the sixties, but there is no account of the preparation of nickel before 1874, since when about 3,600 pouds were smelted. The constant extension of the practical applications of this metal, even for the army, may give a particular importance to the deposits of the Urals, and there is even reason to suppose that with the general scarcity of nickel ores Russia may become one of the chief sources of this metal.

The iron industry.

The working of iron ores and their treatment in cold blast furnaces was carried on from ancient times in the government of Novgorod in the neighbourhood of Ustiuzhina, afterwards called Zhelesnopol. To this day there exist many traces of these workings in the present government of Olonets and at the village of Dedilov in the government of Tula. The manufacture of pig iron and the treatment of iron on a larger scale was first developed in central Russia and in the governments of Olonets and Perm where not only rich deposits of ore but also an abundance of wood occur, together with other natural and economical conditions favourable to the development of the iron industry. By degrees the number of works increased and the iron industry took root in localities where it had previously not existed. Still the chief centres of the iron industry were always the Urals, central Russia and Poland, but in recent times the greatest production is given by South Russia *.

The works of eastern Russia, namely of the governments of Perm, Viatka, Ufa and Orenburg belonging to the so-called mining regions of the Urals, chiefly smelt magnetic and brown iron ore. Red hematite, siderite and sphero-siderite are smelted in comparatively small quantities. The most remarkable deposits of magnetic iron ore occur at Mounts Blagodat and Visokaia in the central Urals in the government of Perm and at Mount Magnitnaia in the south Urals, government of Orenburg. The deposits of Mount Visokaia, which furnish several mining districts with ore, yield above eight million pouds annually. This ore contains from 63 to 69 per cent of iron and can be smelted without the addition of any fluxes. Mount Blagodat annually yields over three million pouds of ore, containing from 52 to 58 per cent of iron. This ore, however, requires the

* See map of the iron and steel producing regions.

addition of a small quantity of limestone flux. The ore of Mount Magnitnaia is very pure and rich, containing as much as 66 per cent of iron, nevertheless this deposit is very little worked owing to its distance from iron works and the want of means of communication.

Besides these three chief localities a more or less considerable amount of magnetic iron ore is yielded from several deposits on the eastern side of the Urals. In 1874 an extensive deposit of specular iron was discovered in the north of the Urals and in 1890 the Koutimsk iron works were built for smelting this ore. Most extensive deposits of brown iron ore of a very high quality, yielding pig iron suitable for the Bessemer process, occur in the central and south Urals. This ore sometimes gives as much as 60 per cent of iron in smelting. Deposits of spherosiderite occur in many parts of the government of Viatka and in the western portion of the government of Perm. In general these ores are not rich and contain some phosphorus.

The deposits of red hematite on the western slopes of the Urals deserve special mention. The ore here occurs in strata of the carboniferous formation and yields as much as 64 per cent of iron in smelting. In speaking of the iron ores of the Urals, it is impossible to avoid mentioning the deposits of chrome iron ore, which occur in several localities in this region. The chrome iron ore here produced is partly smelted in blast furnaces and partly exported. The ore contains from 35 to 38 per cent of oxide of chromium and about 40 to 50 per cent of iron.

The iron district of central Russia includes the governments of Nizhni-Novgorod, Vladimir, Riazan, Tula, Kalouga and Oriol. The ores worked are brown iron ore and siderite. As a rule the ores of Central Russia are easily reducible but in the majority of cases are not distinguished either for their richness or purity as they often contain phosphorus. However, they are very suitable for the manufacture of cast iron.

The government of Olonets and Finland are rich in lake and bog iron ores. Unfortunately the majority of these ores are poor and phosphoritic. Numerous deposits of other iron ores, such as magnetic iron ore and specular iron, are known in these localities. Numerous deposits of brown iron ore occur in the west of Russia in the governments of Vilna, Minsk and Volyn. A considerable quantity of spherosiderite containing from 27 to 35 per cent of iron and brown iron ore with from 35 to 45 per cent of iron is raised in the south and west of Poland, but the majority of these ores are phosphorites.

From the time of its exploration by the French savant Le Play, the Don coal basin of the south of Russia has always been known to be exceedingly rich in iron. The ores of this district are chiefly brown iron ore which occurs in strata of the carboniferous formation. Besides this, in the south of Russia there are vast deposits of exceedingly pure and rich ores with 60 to 68 per cent of iron. These deposits, which chiefly consist of specular iron, magnetic iron ore and red hematite, occur on the borders of the governments of Kherson and Ekaterinoslav in the neighbourhood of the village of Krivoi-Rog. The exploitation of these deposits has been rapidly developed, and in 1890 more than 19,000,000 pouds of ore were yielded by seven mines worked upon the open-working system. Besides this there is a deposit very favourably situated of magnetic iron ore near Korsak-Mogila in the Tauride government about thirty versts distant from Berdiansk, one of the ports of the Azov Sea.

The following table gives the yield of iron ore in different parts of Russia during the last five years.

Regions.	1886.		1887.		1888.		1889.		1890.	
	№ of mines.	Yield of ore. Pouds.	№ of mines.	Yield of ore. Pouds.	№ of mines.	Yield of ore. Pouds.	№ of mines.	Yield of ore. Pouds.	№ of mines.	Yield of ore. Pouds.
Urals	441	41,741,300	490	47,474,500	522	49,264,700	498	51,111,700	435	56,268,200
Central Russia	29	7,134,400	20	8,356,500	20	8,627,300	20	10,228,600	22	12,272,800
South Russia. .	12	5,563,500	15	10,008,300	20	13,994,900	22	21,007,900	22	22,997,500
Poland	69	7,661,000	68	8,782,500	63	12,148,900	79	13,306,500	49	13,394,700
Siberia	8	731,300	9	831,000	7	795,600	4	783,200	5	759,900
North Russia .	10 lakes.	433,700	14 lakes.	509,500	17 lakes.	481,200	1 mine. 13 lakes.	1,009,900	15 lakes.	571,500
Finland	1 mine. 67 lakes.	1,504,900	63 lakes.	6,792,200	132 mine.	2,203,500	1 mine. 164 lakes.	2,660,000	1 mine. 180 lakes.	3,125,000
Total. . .	623 and 77 lakes.	66,460,000	602 and 77 lakes.	82,753,500	632 and 149 lakes.	85,516,100	645 and 177 lakes.	100,107,800	536 and 195 lakes.	109,622,000*

* Including 317,400 pouds in the Caucasus.

The following table gives the amount of iron ores smelted in the blast furnaces of the Empire during the last nine years.

Ores.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Thousands of pouds.								
Magnetic iron ore	11,095	12,193	13,129	13,244	18,924	15,638	18,251	12,763	17,703
Brown iron ore.	35,044	31,131	32,060	34,333	36,879	42,029	43,049	51,101	46,348
Red hematite.								11,206	21,836
Siderite and clay iron stone . .	14,186	17,003	14,310	16,932	12,800	16,790	14,918	8,534	14,013
Lake and bog ore							5,065	1,861	2,938
Other ores . . .							—	—	493
Slag, cast iron and scrap . . .	726	1,244	1,659	2,154	2,674	3,582	4,256	5,728	7,546
Total.	61,052	61,571	61,158	66,664	66,277	78,039	82,539	91,194	110,878

This table shows that between 1882 and 1890 the consumption of magnetic iron ore increased sixty per cent while the consumption of brown iron ore only increased a little over thirty per cent. Red hematite is chiefly smelted by the iron works of south Russia, which consume large quantities of ore from the deposits at Krivy-Rog. A striking feature in this table is the large increase in the amount of slag smelted, which from 726,000 pouds in 1882 rose to 7,546,000 pouds in 1890, that is, more than ten times. About half of this quantity, namely 3,506,000 pouds, was consumed by the tin iron works of Poland, while the thirty-six works of the Urals only smelted 1,372,000 pouds of slag during the same year. This may be ascribed to the fact that in the Urals the ores are far richer in iron than the slags and cost comparatively little, while the works of Poland smelt exceedingly poor ores which, moreover, are rather expensive.

The manufacture of pig iron is mainly carried on by charcoal fuel. The charcoal is either prepared in stoves or in stacks, and chiefly from pine and birch wood. Pine and birch charcoal are preferred for fuel for blast furnaces. In Poland oak and beech wood are also used for the preparation of charcoal for the blast furnace. Sometimes in central Russia and Finland the charcoal is mixed with wood, and peat is occasionally added in Poland. There are also blast furnaces working on a mixture of charcoal and coal. In 1890 there were seven such furnaces in Poland and one in the Urals. In 1890 there were five blast furnaces working exclusively upon coal in Poland and seven in the south of Russia upon coke. At the Sulinovsky works in the south of Russia there was one furnace working upon anthracite.

The charcoal furnaces are frequently very primitive in their design, with massive brick or stone boshes, and cold or feebly heated blast of low pressure. Even in 1870 when the Austrian metallurgist Tunner visited the Urals he expressed his astonishment at the fact that the hot blast was nowhere used. The blast furnaces vary considerably in capacity and height. Thus in Finland, Poland and the government of Olonets the blast furnaces working with charcoal are chiefly small, not exceeding thirty to thirty-five feet in height; but in the Urals they are large and high, fifty feet and more, the furnaces of central Russia being intermediate between the two. In general the

furnaces of recent construction are distinguished for their large capacity, greater number of tuyeres, from three to twelve, which are often cooled by a current of water. In the new furnaces the hearth is accessible from all sides and like the shaft is most often built of brick. The external walls of the new furnaces are made comparatively thin and some are built upon the Scotch system without external casing. The furnaces of the newest pattern are generally furnished with a gas-collecting apparatus and work with a hot blast. The blast furnaces working with mineral fuel are for the most part of the newest construction with an annual yield of two and one-half million pouds of pig iron.

The changes which the manufacture of pig iron has undergone during the last ten years are seen in the accompanying table giving the number of furnaces worked with cold and hot blast and the production of pig iron with charcoal and mineral fuel.

Years.	№ of furnaces.			Production of pig iron in pouds.		
	Cold blast.	Hot blast.	Total.	Charcoal fuel.	Mineral fuel.	Mixed fuel.
1881	—	—	196	26,446,443	2,215,277	—
1882	110	90	200	25,757,688	2,479,339	—
1883	106	96	202	26,660,810	2,746,121	—
1884	91	107	198	28,327,752	2,777,860	—
1885	88	107	195	28,660,621	3,003,563	541,320
1886	85	107	192	27,145,526	4,142,775	1,196,116
1887	70	119	189	30,184,803	5,990,827	1,213,641
1888	67	133	200	31,083,651	8,267,697	1,364,328
1889	74	139	213	31,602,782	11,968,222	1,609,301
1890	69	145	214	37,326,643	18,278,381	955,050

This table shows that while in 1882 fifty-five per cent of the blast furnaces in Russia worked with cold blast there only remained thirty-two per cent in 1890. During the same period the number of furnaces working upon mineral fuel increased from three to thirteen. As regards the production of pig iron with mineral fuel, in 1881 it did not exceed 7·7 per cent of the total production of the Empire, while in 1890 it had risen to 32 per cent of the total, having increased over eight fold during the ten years.

The iron works of Russia were formerly for the most part built on the banks of dammed up rivers. These works enjoy an immense supply of water which they store in vast reservoirs, often several square versts in area. The works therefore chiefly depend upon water power and are generally furnished with water wheels, which however are now being replaced by turbines and steam engines. The following table compares the number of different engines employed in the iron works of Russia in 1882 and 1890.

Class of Engine.	1882.		1890.	
	Number.	H. P.	Number.	H. P.
Water wheels	1,547	27,097	931	20,507
Turbines	163	8,261	362	18,593
Steam engines	726	31,432	904	57,148
Portable engines.	74	—	126	—

This indicates a distinct progress in the application of steam power and turbines to the iron industry.

In the Urals forge pig iron is chiefly produced, especially if the ore used is magnetic iron. Thanks to the comparative purity of the ore from the chief deposits of the Urals the pig iron produced therefrom is distinguished for its great purity and is often quite suitable for conversion into steel. Foundry pig iron of excellent quality is smelted at certain works in the governments of Perm and Viatka. The Kousinsk and Kaslinsk works are known for the fineness of their castings made direct from the blast furnace. The works of central Russia, Poland and Finland manufacture both forge and foundry pig. The works of the government of Olonets prepare the latter exclusively, while only one blast furnace of the large works, built in the south of Russia and smelting with mineral fuel, produces foundry pig iron.

The greater portion of the pig iron smelted in Russia is converted into iron and steel by means of fuel supplied from the same forests which furnish the blast furnace with fuel. Only the south of Russia and Poland take advantage of the local coal for this purpose. Coal imported, chiefly from England, is used by the iron and steel works in St. Petersburg and its neighbourhood, and also by some of the works in the interior.

Turning to the actual manufacture of iron it is seen that up to about 1850 it was almost entirely conducted in bloomery furnaces. It was not before 1845 that the Ural iron works began to replace the ordinary bloomery furnaces for the kantouaz pattern, and afterwards to introduce the puddling process, which was also introduced into the governments of central Russia about the same time. The bloomery process still continues to be employed in the Urals but in other parts of Russia it has been quite supplanted by the puddling process. In 1890, 377 or 84 per cent of the 451 bloomery furnaces in work in the whole of Russia belonged to the iron works of the Urals, and about 30 per cent of the iron produced in this district is obtained by the bloomery process. The continuation of the bloomery process in the Urals is partly due to the fact that the forests having gradually receded from the works, it is impracticable to transport the wood required for the puddling furnace, while the charcoal for the bloomery process is far more easily conveyed to the works, another reason being that some markets, such as the Asiatic, have a special demand for bloomery iron.

The puddling furnaces are either simple draught, gas simple draught, or Siemens furnaces. The gas simple draught furnaces are for the most part after Bäetius pattern. Although as a rule the puddling works, being of newer construction, are more complete than the bloomery and blast furnace works, still the employment of the waste heat from the puddling furnaces is rarely met with.

The manufacture of steel has been rapidly developed during the last twenty-five years. The reason of this will be discussed in speaking of the rail industry. Here it will only be mentioned that in 1851 Mr. Oboukhov, a mining engineer, invented a process for the preparation of crucible steel on a large scale. At first only cuirasses and swords were manufactured out of this steel, but it was soon employed for casting guns. The Zlatoust works were then built for this purpose and turned out ordnance of high quality. The difficulty of transporting heavy ordnance from the Zlatoust works to the fortresses, chiefly situated upon the shores of the Black and Baltic seas, induced the Government to build a cast iron and steel gun factory near the town of Perm on the river Kama. The crucible process was introduced at these works for the preparation of steel.

The Perm steel gun factory was constructed by Mr. Vorontsov, mining engineer, who in 1875 also erected a fifty-ton steam hammer for the works. The bed of this hammer weighed 525 tons and was cast in one piece. At that time this casting was unequalled throughout the world.

When the Zlatoust works were closed Mr. Oboukhov erected a steel gun factory near St. Petersburg; this factory now belongs to the Government. In the manufacture of steel it has been Russia's endeavour to keep pace with foreign works. When the Bessemer process was first announced several Government and private works in the Urals began to make experiments with a view to adopting it. The preparation of steel from phosphortic pig by the Gilchrist process was also quickly adopted in Russia. The accompanying three tables show the gradual process of development in the manufacture of pig iron, iron and steel in Russia. The data respecting pig iron begin from 1822; iron, from 1837; and steel, from 1847.

Production of pig iron.

Years.	Production of pig iron.	Average yearly production.	Years.	Production of pig iron.	Average yearly production.
	Pouds.			Pouds.	
1822—1825	36,616,164	9,154,041	1856 - 1860	82,809,707	16,561,941
1826—1830	53,711,844	10,742,377	1861—1865	88,328,097	17,665,619
1831—1835	52,498,248	10,499,850	1866—1870	97,981,395	19,596,279
1836—1840	54,596,471	10,919,294	1871—1875	119,084,592	23,816,918
1841—1845	56,030,734	11,206,147	1876—1880	130,754,907	26,150,981
1846—1850	62,515,519	12,503,104	1881—1885	149,616,794	29,923,359
1851—1855	69,717,572	13,943,514	1886—1890	212,329,743	42,465,949

Production of iron.

Years.	Production of iron.	Average yearly production.	Years.	Production of iron.	Average yearly production.
	Pouds.			Pouds.	
1837 - 1840	27,134,154	6,783,538	1866—1870	65,962,111	13,192,422
1841—1845	38,167,751	7,633,550	1871—1875	84,406,478	16,881,296
1846—1850	43,763,406	8,752,681	1876—1880	85,773,167	17,154,633
1851—1855	54,011,452	10,802,290	1881—1885	99,929,753	19,985,951
1856—1860	58,410,847	11,682,169	1886—1890	119,530,506	23,906,101
1861—1865	56,266,163	11,253,233			

Production of steel.

Years.	Production of steel.	Average yearly production.	Years.	Production of steel.	Average yearly production.
	Pouds.			Pouds.	
1847 1850	250,337	62,584	1871—1875	2,863,838	572,768
1851—1855	347,714	69,543	1876—1880	39,301,366	7,860,273
1856—1860	519,260	103,852	1881—1885	70,985,080	14,197,016
1861—1865	811,738	162,348	1886—1890	80,996,150	16,199,230
1866 - 1870	2,232,414	446,483			

The above tables show that during the last seventy years the production of pig iron has only increaced by four and a half times, and that at the present time Russia, which seventy years ago produced one and one-half times as much pig iron as France, four and a half times as much as Germany, three times as much as Belgium and as much as the United States, stands far behind all these countries in its production of pig iron. The chief reason for this regrettable state of affairs most certainly lies in the fact that Russia, owing to the force of circumstances, has always been dependent upon charcoal for the manufacture of its pig iron, while the other nations, having applied mineral fuel in far greater proportions or having totally ceased smelting pig iron with charcoal, have made rapid strides and have forged ahead. Moreover, the active rise in the production of pig iron during the last five years was mainly due to the firm establishment of its manufacture with mineral fuel, and there is every reason to foresee that the south of Russia will rapidly develop its production to an exceedingly large extent, and that the chief production of pig iron in Russia will be concentrated, just as it is in western Europe and America, where rich deposits of iron ores occur in the near neighbourhood of coal veins suitable for metallurgical purposes.

The combined production of iron and steel has also increased by four and one-half times during the last forty-five years. The manufacture of iron and steel is not subject to any Government tax, but a mining duty is collected on the production of pig iron. This duty amounts to one and one-half kopecks per poud on the pig iron smelted at freehold works, and two and one-half on that smelted at works leased from the Government. The revenue thus brought to the Government by the private iron works averages from six to seven hundred thousand paper roubles a year.

Before reviewing the production of the different iron centers of Russia it may be well to refer briefly to the history of the iron industry in the chief of these centres. In the Urals the metallurgical industry began to take root in the beginning of the seventeenth century when the Government built the first iron works. The discovery of iron ores near the river Nitsa was followed in 1631 by the erection of the first iron works in the Urals, called the Nitsinsk works. At these works, as was usual in those days, wrought iron was manufactured directly from the ore in hearths with an artificial blast. The metallurgical industry was placed on a perfectly firm footing in the Urals by Peter the Great, who in 1701 ordered the construction of the Niviansk and Kamensky Iron works. Cast iron cannons and projectiles were manufactured at both these works. Many other Government works were afterwards created in various parts of the Urals. Peter the Great and his successors evinced great energy and solicitude in establishing a private mining industry and thanks to the measures taken by the Government, nearly all the works now existing in the Urals were created within the space of a few decades. The most active helper of Peter the Great in establishing the metallurgical industry was William de Hennin, a native of Nassau, who from 1722 to 1734 was the head of the Siberian and Ural works, and erected many others. His predecessor and successor Tatischev also did much for the mining industry of Russia.

In speaking of the private mining industry of the Urals it would be impossible to avoid mentioning the active work done by Nikita Demidov, formerly a blacksmith of Tula. He was known personally to Peter the Great, who gave over the Niviansk works to his charge under the condition that Demidov should make cannons, mortars, cold arms, as well as manufactured iron and wire at these works. Thanks to his unusual

perseverance Nikita Demidov erected four more works in the Urals; indeed, he and his descendants built altogether thirty works in the Urals.

At the close of the sixteenth and beginning of the seventeenth centuries Russia was supplied with iron from Sweden, whence it was imported by Dutch merchants through the port of Archangel. The high price of this metal, induced one Vinius, a Dutch merchant settled in Russia, to erect works at Tula, for casting objects of iron and for manufacturing iron by the foreign method. He was granted permission to do this in 1632 by the Tsar Michael Fedorovich. Vinius erected four works on the banks of the river Toulitsa. He was subsequently joined by two other foreigners, who erected several new works in the governments of central Russia. It was also at Tula that Peter the Great became acquainted in 1696 with the blacksmith Nikita Demidov Antoufiev, from whom the family of the Demidovs descended, and who attracted the Emperor by his talent, skill and rare perseverance. Nikita Demidov rendered immense service in the development of the mining industries, of not only central Russia, but also of the Urals and Siberia.

Iron ores were first discovered in the government of Olonets in 1670 and their exploitation was soon given to Butenant von Rosenbusch a native of Denmark under the condition that he should furnish the Government with cannons and projectiles manufactured at the Petrovsk works erected in 1678. These works were subsequently taken over by the Government and their direction handed over to De Hennin who with the aid of foreign foremen introduced the manufacture of steel, sheet iron, anchors, wire and nails at these works and also placed them in a position to satisfy the requirements of the navy.

The Government, actively following up the idea of developing the production of iron in Russia with mineral fuel, has constantly held in view the establishment of independent iron works in the south of Russia, where both the pig iron and manufactured iron, transported from the Urals at a distance of two thousand versts, became so dear that it hindered and injured the industries and especially the agricultural interests of the district. From the very foundation of the Lougansk works in the government of Ekaterinoslav in 1797 up to the thirties of the present century experiments were made upon smelting pig iron from local ores and coal which, however, for various reasons were unsuccessful. Likewise, the works erected in Kertch in 1845 for the purpose of smelting local ores with anthracite from the Don basin also failed to give good results.

Experiments were then again carried on in the Donets basin and the Petrovsk iron works erected there in 1859. The Lisichansk iron works were then completed in 1870 and after the failure attending the Petrovsk works the experiments were transferred to these works. Here again the results were not satisfactory. Thus the repeated endeavours of the Russian Government to establish the manufacture of pig iron with local mineral fuel in the south of Russia remained unsuccessful. The honour of having attained success in this matter is due to John Hughs, a native of England and to a Russian capitalist named Pastoukhov. John Hughs, formerly chief foreman at the Millwal Iron works, London, signed a contract with the Russian Government in 1869, and having obtained large orders for rails at a high price, he agreed to erect a blast furnace capable of turning out two hundred tons of pig iron a week and to lay out a mine which would give two thousand tons of coal per day. In April, 1871, the first blast furnace was

blown in, a second was erected in 1876 and at the present time these works possess five furnaces and produce six million pouds of pig iron, one million pouds of iron, and three million pouds of steel and rails annually. Mr. Pastoukhov began to erect iron works in the Don province almost simultaneously with Hughs. These works manufacture pig iron with the local anthracite and the first pig iron was obtained during the autumn of 1872, but for various reasons the production of these works has not been as great as could be desired.

The discovery and detailed exploration of the extremely rich iron ore deposits of the Krivoi-Rog was followed by the establishment of several large enterprises in the south of Russia and the erection of vast iron and steel works. The first pioneers in this direction have found many followers and it may be confidently expected that in a short space of time the iron industry of the south of Russia will be developed to such a vast extent that the Ural works, after having existed over a hundred and fifty years, will be obliged to cede their precedence.

In the last partition of Poland, the land on which the iron industry first arose in the thirteenth century, was divided between Prussia, Austria and Russia. In 1814 there were forty-six blast furnaces within the limits of the then Principality of Warsaw. The period between 1833 and 1837 was remarkable for the introduction of the hot blast puddling process and the employment of coal in the manufacture of iron. The iron industry of Poland made particular progress about twelve years ago when large iron and steel works were erected by foreign capitalists.

The production of pig iron in Russia during the last ten years is given in the following table.

Production in pouds.

Years.	Iron works.									
	Government.	His Majesty's Cabinet.	Private.							
			Urals.	Central Russia.	South and south-west Russia.	Siberia.	Poland.	North Russia.	Finland.	Total.
1881	3,655,386	20,200	15,936,756	3,387,296	1,583,244	234,521	2,552,289	—	1,282,028	28,661,720
1882	3,238,454	89,045	15,661,347	3,320,911	2,004,734	291,231	2,366,345	—	1,264,960	28,237,027
1883	3,497,423	67,157	16,623,412	3,418,182	1,988,106	304,843	2,494,279	—	1,013,529	29,406,931
1884	3,379,391	148,320	17,879,919	3,661,955	2,031,119	335,469	2,356,926	—	1,312,513	31,105,612
1885	3,658,791	136,977	18,366,401	3,648,661	2,242,720	287,210	2,466,892	—	1,397,852	32,205,504
1886	3,451,291	192,839	17,806,958	3,991,857	3,077,503	226,357	2,881,690	—	905,922	32,484,417
1887	3,395,819	177,941	20,362,807	4,374,064	4,158,431	223,587	3,717,500	—	979,122	37,389,271
1888	3,789,384	102,799	20,648,906	4,605,724	5,432,681	192,301	4,782,570	—	1,161,311	40,715,676
1889	3,554,119	135,335	21,537,733	5,107,640	8,468,005	177,217	5,380,901	—	819,355	45,180,305
1890	4,160,600	159,459	24,012,529	5,753,708	13,417,718	278,923	7,423,961	5,046	1,348,160	56,560,074

The figures of this table show that altogether the production of pig iron in Russia has almost doubled during the last ten years. Taking the separate districts it is seen that the Ural private works have increased their production by fifty per cent, the works of Central Russia, by seventy per cent. The production of South Russia has

increased by eight and one-half times and of Poland by almost three times. The extent to which the general aspect of the production of pig iron according to the chief centres has changed, is seen in the following comparison of relative production for 1881 and 1890.

Years.	Government works.	Private works.				
		Urals.	Central Russia.	South Russia.	Poland.	Finland.
	Percents.					
1881	12·5	55·5	11·8	5·5	9	4·4
1890	7·3	42·4	10·1	23·7	13	2·3

During the last ten years the production of manufactured iron has varied in the following manner.

Production in pouds.

Years.	Works.									
	Government.	His Majesty's Cabinet.	Private.							Total.
			Urals.	Central Russia.	Poland.	South and south-western Russia.	North Russia.	Siberia.	Finland.	
1881	772,581	16,982	10,374,322	2,016,704	1,399.165	568,965	1,655,577	150,449	884,454	17,839,199
1882	512,674	22,291	10,007,083	2,744,010	1,518,423	670,695	1,519,925	155,827	1,000,882	18,151,810
1883	725,093	14,453	10,657,622	2,670,890	1,995,961	423,050	1,983,484	140,049	1,096,692	19,707,294
1884	934,743	44,199	11,244,379	2,768,228	3,498,644	616,086	1,717,606	163,644	1,126,637	22,114,166
1885	988,856	64.469	11,143,933	2,097,471	4,197,263	761,761	1,537,847	152,932	1,172,752	22,117,284
1886	872,359	77,264	11,445,827	1,651.693	4,585,844	857,600	1,917,332	142,752	610,677	22,161,348
1887	1,122,896	51,285	12,285,738	1,844,841	3,809,071	794,674	2,073,891	104,030	463,376	22,551,902
1888	1,006,492	71,244	12,481,214	2,234,780	3,238,640	1,001,027	1,601,568	114,733	505,634	22,255,332
1889	1,282,475	77,578	13,701,259	2,692,992	4,051,359	1,501,301	2,208,120	111,576	489,719	26,116,379
1890	1,187,718	91,176	13,654,191	3,082,641	4,137,237	1,578,700	1,792,526	173,626	747,730	26,445,545

The total production was divided in the following manner according to the sorts of iron.

Years.	Bar and assorted iron.	Sheet and roofing iron.	Boiler and armour plate iron.
	Pouds.		
1882	13,308,823	4,110,417	732,570
1883	14,713,281	4,467,366	524,147
1884	15,425,533	5,782,249	906,384
1885	16,095,299	4,944,559	1,077,426
1886	15,198,885	5,621,607	1,119,460
1887	15,706,551	5,611,496	1,233,855
1888	15,909,589	5,009,867	1,302,621
1889	18,037,914	5,897,354	1,392,808
1890	17,861,647	5,765,166	1,449,255

At the present day iron and steel are so often applied to one and the same purpose, and steel has in so many cases replaced iron that the one cannot be spoken of without mentioning the other, and therefore the production of steel in Russia during the last ten years may now be considered.

Production of steel in pouds.

Years.	Works.									Total.
	Government.	His Majesty's Cabinet.	Private.							
			Urals.	Central Russia.	Poland.	South Russia.	North Russia.	Siberia.	Finland.	
1881	163,420	501	1,826,374	3,575,129	3,902,267	1,266,748	7,146,558	—	26,383	17,907,380
1882	323,808	500	1,186,022	3,281,549	3,319,163	1,467,810	5,524,739	640	16,011	15,120,242
1883	178,510	504	1,598,717	3,023,410	3,434,834	1,118,963	4,183,340	1,078	16,628	13,545,984
1884	245,415	502	2,122,107	2,234,153	3,428,350	1,294,695	3,223,395	—	86,580	12,635,197
1885	220,173	252	1,915,600	1,524,699	2,446,012	1,955,757	3,498,899	2,387	217,548	11,776,277
1886	266,854	258	2,049,591	1,778,420	3,151,567	2,815,518	4,521,306	187	177,633	14,761,329
1887	325,255	253	2,002,976	2,265,864	3,048,327	2,488,743	3,509,711	187	125,021	13,765,537
1888	279,514	—	2,121,590	2,445,130	3,137,227	2,405,381	3,102,735	790	78,368	13,570,735
1889	442,475	—	2,140,808	4,014,386	2,390,407	3,721,399	3,026,232	1,415	58,630	15,795,752
1890	371,783	—	2,344,455	5,248,589	3,365,673	7,043,547	4,577,338	1,250	150,162	23,102,797

Data respecting the production of steel of various kinds can only be given for the last three years, as below.

Years.	Production of steel in pouds.				
	Cementation steel.	Puddled steel.	Bessemer steel.	Marten steel.	Crucible steel.
1888	118,754	145,587	3,125,100	9,921,118	260,181
1889	107,888	223,185	4,863,780	10,298,453	302,446
1890	88,293	26,265	7,221,428	15,436,034	330,777

And lastly the following table gives the production of steel rails and of sheet and assorted steel during the last ten years.

Years.	Steel rails.	Assorted steel.	Sheet steel.
1881	12,611,872	93,911	198,898
1882	9,356,805	482,989	342,726
1883	7,854,875	865,019	432,352
1884	5,998,617	1,103,833	372,342
1885	5,831,669	1,405,648	234,226
1886	6,959,742	1,142,940	562,882
1887	5,309,672	2,034,839	1,365,754
1888	3,847,945	1,221,265	1,290,559
1889	5,394,338	2,948,669	983,346
1890	10,140,874	3,833,626	1,276,353

The total production of iron and steel taken together has increased by 38·6 per cent since 1881. Taking the different iron-producing regions separately the following changes in the production during the last ten years may be deduced: that of the Government works has increased by 66 per cent; of the Ural private works, by 31 per cent; of Central Russia, by 50 per cent and of Poland, by 41 per cent. In South Russia the production of iron and steel has increased nearly fivefold, while that of the works of northern Russia has fallen about 25 per cent.

The production of different sorts of iron and steel has gradually and somewhat uniformly risen. The manufacture of steel rails has been subject to great fluctuations owing to their demand depending upon the erection of new and the re-equipment of the already existing railroads.

The manufacture of rails in the Empire has its history. When Russia first began constructing its railroads the Government made every endeavour to encourage the manufacture of rails by private individuals. When the Chief Company of Russian Railroads was instituted, about 1855, the Russian iron-masters were invited to supply the necessary rails, but only four works in the Urals appeared in answer to the invitation, and only two of these took the matter in hand, supplying 3,250,000 pouds of iron rails between 1856 and 1860, after which they refused to manufacture more. Since then certain works have undertaken orders for the manufacture of small parcels of rails. In the mean time the Poutilov works near St. Petersburg started turning over old iron rails and giving them steel heads.

The importance of the production of rails to Russia, will be better understood by showing the gradual progress of the construction of railroads in the Empire, Finland excluded.

In 1838 . . .	— 25	versts.	In 1875 . . .	— 17,718	versts.
» 1850 . . .	— 468	»	» 1880 . . .	— 21,226	»
» 1860 . . .	— 1,490	»	» 1885 . . .	— 24,258	»
» 1865 . . .	— 3,577	»	» 1890 . . .	— 28,581	»
» 1870 . . .	— 10,090	»	» 1892 . . .	— 29,156	»

In 1866 a project was made for the erection of large rail-rolling works in the south of Russia, but Mr. Reitern, then Minister of Finance, expressed the opinion that it was impossible to stop the construction of railroads indispensable to Russia until the rail-rolling industry, then in its infancy, could be sufficiently developed. It was, therefore, decided to encourage reliable private companies to erect rail-rolling mills in the south of Russia, but not to stay the construction of railroads. As the above data show, the construction of railways was most energetically carried out between 1868 and 1878 and during these years over ninety million pouds of iron and steel rails were imported at a cost of over a hundred and fifty million roubles.

It was during this period that John Hughs in 1873 started the production of rails in the south of Russia. In 1874 the Briansk rail-rolling works erected by Messrs. Goubonin and Goloubev in the government of Oriol, began working, and lastly in 1875 the Nizhni-Saldinsk works of Prince Demidov San Donato, were the first to start the manufacture of steel rails in Russia. In 1875 the manufacture of rails was revolutionized, owing to the generally recognised necessity of changing iron for steel rails.

In 1876, because of the constantly increasing importation of foreign rails, the Russian Government found itself obliged to issue a series of measures, which were adopted in

view of the development of the home-rail production. These measures were the following: 1. the institution of a poudage bounty on the manufacture of steel rails, by independent works, from Russian pig iron and by iron works using old rails; 2. the issue of Government orders for fifteen million pouds of rails; 3. the prohibition of the free importation of rails.

The result of these measures was that the three already existing rail-rolling works were rendered capable of making steel rails, and furthermore, four more steel rail-rolling works were erected in various parts of Russia, so that counting the Demidov works in the Urals, which had been previously capable of turning out steel rails, there were at that time altogether eight rail works in the Empire.

The following table gives the number of workmen employed in the iron industry, that is, in iron mines and works, during the last five years.

	1886.	1887.	1888.	1889.	1890.
In the Urals	145,910	174,018	177,188	158,486	165,057
» Central Russia	21,187	20,183	19,954	21,858	25,754
» Poland	11,021	10,341	12,234	12,460	11,376
» South and south-west Russia	5,956	6,603	9,260	10,294	15,698
» North Russia	9,382	9,254	7,028	8,481	10,652
» Siberia	2,380	1,814	1,933	2,422	1,930
» Finland	1,652	2,524	3,162	2,636	3,177
Total	197,488	224,737	230,759	216,637	233,644

On comparing this table with that showing the production of the different regions, it is seen that the number of workmen employed is comparatively very high in those regions where the smelting of pig iron and the manufacture of iron and steel is exclusively carried on with charcoal. This is due to the preparation of charcoal, the cutting of the wood inevitably requiring a considerable expenditure of manual labour.

INTERNAL IRON TRADE.

The iron and steel works of the Urals as the most important sources of iron and steel are now connected on the southern side only by an uninterrupted railway line with the general railway system of the Empire; but on the other hand they enjoy an exceedingly vast system of water communication transporting their produce along the rivers Chusovaia, Belaia and Viatka to the Kama and thence to the Volga. This cheap route, as much as two thousand versts long, opens out an immense market to the iron industry of the Urals, the entire length of the Volga, the Transcaspian provinces and Persia and with the canals, there is also access to the White, Baltic and Azov seas. However, the advantages of this route are limited by the fact that it is only practicable for six or seven months in the year, so that during the rest of the year the majority of the Ural works have no communication with the consumers of their produce and are obliged to keep a large amount of capital idle, without returns.

The position of the three other chief centres of the Russian iron trade, namely Poland, Central and South Russia, is much more propitious in this respect, owing to their being in connection with the general railway system of the Empire, and to their proximity to the consuming markets. The chief market for the Urals is that of Nizhni-Novgorod to which are sent from seven to eight million pouds of iron product every year. The other chief markets for pig iron and manufactured iron, are St. Petersburg, Moscow, Warsaw, Odessa, Riga and Rostov-on-Don. These towns obtain their iron and steel from one or other of the iron centres, according to their proximity or convenience of transport.

The external iron and steel trade and the fiscal regime to which it is subjected, play an exceedingly important part in the economical condition of Russia.

In the middle of the past century Russian iron formed one of the chief articles of export, and in 1782, amounted to 3,840,000 pouds, to the value of more than five million roubles. At the close of the last century Great Britain alone imported annually about two million pouds of iron from Russia; but at the beginning of the present century the export decreased, owing to the development of iron works in other countries, especially in England. Up to 1862 Russia was able to satisfy its internal demand for pig iron, iron and steel by its own product; but since 1863 the demand for iron has increased, chiefly owing to the active construction of railroads, and this together with the small progress made by the home production has resulted in a rapid increase in the importation of foreign iron.

Up to 1857 the Government held a prohibitory system with regard to the importation of iron and steel; but the prohibition against the importation by sea, with the exception of the ports of the Sea of Azov, of pig iron and manufactured iron was recinded by the customs tariff of 1857, and a duty of 15 kopecks a poud was put upon pig iron and of 50 to 90 kopecks upon iron. However, in 1859 these duties were lowered to 5 kopecks upon pig iron and 35 kopecks upon bar, scrap iron and rails, 45 kopecks upon manufactured iron and 75 kopecks upon boiler plate, retort, sheet and armour plate. The duty upon steel was then 70 kopecks a poud. In 1868 the duty on pig iron remained unchanged, but that on bars, scrap and assorted iron was altered to 36 kopecks; sheet, boiler plate, armour plate and retort iron, to 50 kopecks; rails, to 20 kopecks; and steel, to 80 kopecks. The prohibition against the importation of pig and manufactured iron by the ports of the Azov was also abolished at the same time.

The lowering of the import duties upon iron coincided with a considerable animation in the construction of railroads, and therefore the importation of iron rose rapidly, and in 1870 amounted to over eighteen million pouds, that is, two and one-half million pouds above the production at home. The general application of steel in the place of iron rails, induced the Government in 1871 to lower the duty upon steel rails to 45 kopecks per poud instead of 80 kopecks to which they were previously subjected as steel goods.

Starting from 1881 the duties upon pig iron, iron and steel were gradually raised in order to protect the home industry. Thus, in 1884 a progressively rising duty upon pig iron was instituted for a period of three years, thus, from June 1, 1884, to March 1, 1885, the duty upon pig iron, imported by land or sea, was 9 kopecks, from March 1, 1885, to March 1, 1886, 12 kopecks, and from March 1, 1886, the duty was 15 kopecks in gold per poud. In 1887 this duty was again increased, as follows: for pig iron imported by sea, to 25 kopecks per poud, and for pig iron imported by land, to 30 kopecks in gold per poud.

The duties upon iron and steel were also gradually raised in 1881, 1882, 1885 and 1887. Those instituted in 1887 were as follows: a. bar and assorted iron, blooms, puddled ingots or mill bars, steel bars and ingots, and all kinds of assorted steel, 50 kopecks in gold per poud; b. iron and steel rails, 50 kopecks in gold per poud; c. sheet and plate iron and sheet and plate steel over 18 inches wide, and assorted iron and steel over 18 inches wide or high, or having a diameter of 7 inches and above, as well as fine assorted iron and steel from one-quarter to one-half of an inch inclusive in diameter or width, 70 kopecks in gold per poud; d. iron one-quarter of an inch and less in diameter or width is counted as wire and pays a duty of 1 rouble 10 kopecks in gold per poud.

The following tables give the amount of pig iron, iron and steel imported into Russia during the years from 1881 to 1890.

Importation of Pig iron.

Years.	Importation of pig iron.	Years.	Importation of pig iron.
1881	14,293,000	1886	16,178,802
1882	13,363,000	1887	7,877,613
1883	14,491,000	1888	4,590,877
1884	17,330,000	1889	7,182,890
1885	13,509,000	1890	7,712,600

Importation of iron of various sorts.

Years.	Bar, scrap and assorted iron.	Sheet iron, boiler and plate iron.	Iron rails.	Total.
	Pouds.			
1881	4,633,000	1,853,000	58,000	6,544,000
1882	4,573,000	2,136,000	55,000	6,764,000
1883	3,702,000	2,770,000	39,000	6,511,000
1884	2,660,000	2,211,000	11,000	4,882,000
1885	2,250,000	1,628,000	37,000	3,915,000
1886	3,358,221	1,400,073	22,727	4,781,021
1887	2,206,173	1,164,697	6,386	3,377,256
1888	2,616,671	1,396,745	11,711	4,025,127
1889	3,372,975	1,880,554	29,846	5,283,375
1890	3,825,598	2,008,262	46,625	5,880,485

Importation of steel of various sorts.

Years.	Bar, scrap and assorted steel.	Sheet and plate steel.	Steel rails.	Total.
	Pouds.			
1881	540,000	90,000	820,000	1,450,000
1882	262,000	19,000	286,000	567,000
1883	194,000	37,000	79,000	310,000
1884	263,000	75,000	133,000	471,000
1885	211,000	57,000	125,000	393,000
1886	525,449	140,364	43,854	709,667
1887	309,291	140,426	17,559	467,276
1888	458,666	120,241	13,169	592,076
1889	742,023	163,535	73,161	978,719
1890	767,494	153,603	103,419	1,024,516

Although up to 1877 the importation of pig iron into Russia did not exceed three million pouds a year, yet in 1878 it began rapidly to increase. This was partly due to the erection of large rail-rolling works, and partly to the erection of works near the frontiers for converting foreign pig into manufactured iron, taking advantage of the difference in the duties upon the two products. However, due to the raising of the duty upon iron partly because of the erection of the above-mentioned works and partly because of the development of the home production, the importation of these metals, which for the five years ending 1878 was about eighteen million pouds a year, began to fall considerably. Besides the above-mentioned iron goods, Russia imports a considerable quantity of tin plate. In 1888 the importation of tin plate amounted to 964,000 pouds, in 1889, to 1,076,000 pouds, and in 1890, to 1,490,000 pouds. This tin plate is almost exclusively imported via Batoum, where it is passed free of duty for the requirements of the local tin case factories making tin cases for transporting the naphtha products abroad. The importation of iron and steel wire during the last five years, 1886 to 1890, has been somewhat constant, varying between twenty-four and thirty-three thousand pouds a year.

The importation of iron and steel from Russia is very small. Still the famous Russian sheet iron and certain other kinds find a market abroad. The following table gives the exports of iron from Russia.

Years.	Sheet.	Scrap.	Other kinds.	Pouds.
	P o u d s.			
1881	120,300	191,400		311,700
1882	97,000	257,200		354,200
1883	181,600	120,900		302,500
1884	144,700	160,700		305,400
1885	134,500	96,400	119,700	350,600
1886	124,100	108,300	209,000	441,400
1887	94,400	143,600	124,700	362,700
1888	47,600	60,900	104,700	213,200
1889	60.600	125,900	127,400	313,900
1890	84,700	106,600	114,000	305,300

Although Russian sheet iron goes almost exclusively to the foreign markets of Great Britain, Germany and America, the manufactured iron and iron scrap goes chiefly to Persia.

The following three tables show which countries chiefly participate in supplying Russia with pig iron, iron and steel.

Countries.	Pig iron and pig iron scrap. 1888.	1889.	1890.
	P o u d s.		
From Great Britain	3,114,000	4,663,800	5,212,800
» Germany	817,200	1,673,800	1,326,500
» Holland	97,800	233,300	220,100
» Belgium	5,800	207,300	111,900
» Sweden	160,400	86,500	110,700
» Austro-Hungary.	152,700	—	98,300
» United States.	—	—	83,800
» Norway	—	—	6,300
» France.	—	—	1,500

Countries.	Bar iron, scrap and assorted iron.			Sheet iron, boiler plate and plate iron.			Iron rails.		
	1888.	1889.	1890.	1888.	1889.	1890.	1888.	1889.	1890.
	Pounds.								
From Germany	1,225,500	1,340,000	1,501,700	441,900	637,100	816,300	8,100	9,400	28,300
» Belgium . . .	392,500	992,800	740,000	240,800	557,000	338,000	600	19,800	5,300
» Great Britain . .	347,900	400,000	364,200	634,200	572,300	711,400	2,800		10,400
» Sweden.	100,200	155,100	296,000	8,100	12,600	11,300	—	—	—
» Austro-Hungary	90,400	89,900	218,500	4,300	12,300	51,900	—	—	1,200
» Holland	44,200	83,400	202,100	45,900	75,500	65,100	—	650	—
» Denmark	2,500	9,900	5,500	3,400	—	1,400	—	—	—
» France.	—	—	800	650	3,900	6,000	—	—	-
» Italy.	1,200	—	—	—	—	—	—	—	—
» United States. .	—	2,900	—	—	—	—	—	—	—

Countries.	Steel in bars, scrap and assorted steel.			Steel in sheets and plates.			Steel rails.		
	1888.	1889.	1890.	1888.	1889.	1890.	1888.	1889.	1890.
	Pounds.								
From Germany	208,300	405,000	296,000	70,900	61,200	49,600	700	12,500	19,400
» Belgium	21,600	52,400	234,300	6,700	15,300	14,500	5,000	44,500	65,200
» Great Britain . .	130,900	195,600	148,600	41,500	78,400	68,000	—	1,000	3,600
» Sweden.	11,350	13,400	38,200	—	2,350	—	—	—	—
» Holland. . . .	78,700	41,800	29,500	500	2,500	16,000	—	—	—
» Austro-Hungary .	5,600	16,100	15,400	—	3,400	4,600	—	—	300
» Turkey	—	1,850	1,500	—	—	—	—	—	—
» Italy.	—	—	1,400	—	—	—	—	—	—
» Denmark	—	1,000	700	—	—	—	—	—	—
» France	—	9,300	700	—	—	—	—	—	—

According to the customs tariff of 1891 the following duties were laid on iron and steel.

Paragraph 139; cast iron in pigs, scrap and turnings:

I. All kinds except those especially indicated:

a. Imported by sea, 30 kopecks per poud.

b. Imported by land across the western frontier, 35 kopecks per poud.

II. Ferro-manganese, spiegeleisen, silico iron and chrome iron alloys, 50 kopecks per poud.

Remark: These duties are not subject to alteration before January 1, 1893.

Paragraph 140; I. Bar and all kinds of manufactured iron, except those mentioned below, iron blooms, puddled iron, pieces or ingots, scrap, mill bars, iron powder, 60 kopecks per poud.

II. Iron rails, even if drilled or grooved, 60 kopecks per poud.

III. Sheet iron up to number 25, according to the Birmingham calibre, iron plates over 18 inches wide, all kinds of manufactured iron over 18 inches wide or high, or over 7 inches thick or in diameter, fashioned iron, such as branded, double-branded girders, cross beams and such like, complex profile, except angle iron, which belongs to clause I, manufactured iron of finer calibre, between one-quarter and one-half of an inch in width or diameter, 85 kopecks per poud.

IV. Sheet iron over № 25, according to the Birmingham calibre, 1 rouble per poud.

Remark: Iron less than one-quarter of an inch thick or in diameter pays duty according to paragraph 155, clause 1.

Paragraph 141; Tin plate, polished, stamped with designs, and damascened; sheet iron coloured, polished, coated with zinc, copper, nickel and other metals, 1·70 roubles per poud.

Paragraph 142; steel.

1. Bar and manufactured steel of all sorts, except those specially mentioned below, steel ingots, steel scrap, 60 kopecks per poud.

2. Steel rails, even if drilled or grooved, 60 kopecks per poud.

3. Sheet steel of all kinds up to № 25, according to the Birmingham guage, steel plates over 18 inches wide, all kinds of manufactured steel over 18 inches wide or high and 7 inches in thickness or diameter. Fashioned steel, branded, double-branded girders and cross beams and of other like complex profile, except steel angle, which comes under paragraph 1, fine assorted steel from one-quarter to one-half of an inch in width or diameter inclusive, 85 kopecks per poud.

4. Sheet steel above № 25, according to the Birmingham guage, 1 rouble per poud.

Remark: Steel one-quarter of an inch and less in width or diameter comes under paragraph 155, clause 1.

Paragraph 155; wire.

1. Iron and steel wire.

a. From one-quarter of an inch in width or diameter to № 25, B. G. inclusive, 1 rouble per poud.

b. Above № 25 to № 29 inclusive, 1·50 roubles per poud.

c. Finer than № 29, 2 roubles per poud.

Remark: All wire, coated with tin, zinc or other metals, pays an additional duty of 50 per cent above that to which its guage corresponds.

COAL.

Although coal veins had been known to exist in various parts of European and Asiatic Russia since the last and the beginning of the present century, still up to about 1855, coal was only worked in the south of Russia and Poland, and then the total yield did not even attain ten million pouds. The Government, however, made every endeavour to raise a regular coal industry not only in the Donets and Polish coal fields, but also in central Russia, the Urals, Caucasus and on the island of Sakhalin.

It is impossible not to call attention to the fact that the position of the chief Russian coal fields coincides with other important economical conditions which give a still greater importance to the Russian coal industry [1].

The coal fields of central Russia, known as the Pod-Moscow Coal Basin, are situated on the spot occupied by the oldest and most flourishing manufacturing district. The Donets coal fields are situated in a district perfectly void of forests, and coal is the only fuel for satisfying the wants of the inhabitants and of the railroads for any length of time. The proximity of extremely rich deposits of iron ore gives the right to count upon the development of a vast coal trade in the south of Russia, while the near neighbourhood of the sea gives the possibility of a wide market to this coal. The Ural coal fields coincide with an abundance of mineral wealth which has long been known and valued by the savants of all Europe.

The Kiev-Elisavetgrad coal field is situated in the centre of the sugar industry which alone furnishes a considerable demand for coal; this field gives a brown coal. In western Siberia the Kusnetsk coal basin occurs in the Altai mining district, which is known for the richness of its ore deposits. The coal veins of the Kirghiz steppes will be of great importance in the future when the metallurgical industries are more developed in this forestless district rich in copper, silver and lead ores. In eastern Siberia the coal veins of the island of Sakhalin and those recently discovered on the river Soukhanov give an excellent coal, and guarantee the Russian fleet and merchant vessels on the Pacific ocean a supply of fuel.

In Western Europe and America the largest manufacturing centres have been established and developed to enormous dimensions on their present sites, due solely to the production of coal from veins occurring in the nearest proximity. In Russia on the contrary a demand for combustible material in localities rich in coal existed and grew before the rise of the coal industry. The only exception was Poland where the manufacturing industries acquired their present status chiefly owing to the abundance and cheapness of coal.

An outline of the position of the coal industry in various parts of Rnssia is given below, and the following table shows the gradual progress made during the last thirty-five years.

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[1] See map of the Russian coal fields.

Years.	Coalfields.										Total.
	Donets.	Poland.	Pod-Moscow.	Ural.	Kiev-Elisa-vetgrad.	Caucasus.	Kirghiz stepps.	Kusnetsk.	Island of Sakhalin.	Turkestan.	
	Pouds.										
1855	4,500,000	4,454,000	—	440,000	—	100,000	—	—	—	—	9,494,000
1860	6,009,000	10,788,000	631,000	408,000	—	100,000	185,000	55,000	133,000	—	18,309,000
1865	9,829,000	10,743,000	1,371,000	766,000	—	145,000	202,000	267,000	8,000	—	23,331,000
1870	15,647,000	20,079,000	5,078,500	387,000	—	198,000	478,000	350,000	123,000	75,000	42,416,500
1875	51,437,000	24,904,000	23,659,000	1,279,000	1,093,000	377,000	832,000	256,000	96,000	415,000	104,348,000
1880	86,347,000	78,449,000	25,118,000	7,217,000	534,000	387,000	1,240,000	485,000	502,000	305,000	200,784,000*
1885	114,946,000	109,282,000	21,307,500	10,875,000	555,000	213,000	1,636,000	795,000	550,000	417,500	260,577,500
1890	183,249,000	150,792,500	14,268,000	15,224,000	693,000	605,000	127,000	1,051,500	892,500	301,000	367,203,500

* In 1890, 200,000 pouds of anthracite were raised at Olonets.

The figures of this table clearly indicate the situation of the coal industry in the different fields during the last thirty-five years. Notwithstanding the rapid growth of the yield of coal in Russia the home production cannot satisfy the large and yearly increasing demand, and hence a considerable quantity is imported. The total amount of coal now consumed in Russia amounts to 460 million pouds annually, which with a population of 117 million amounts per year to about four pouds per capita. Exact data respecting the consumption of coal only exist for the railroads, and the following table shows the gradual growth of their demand.

Years.	Consumption of coal.		
	Russian.	Foreign.	Total.
	Pouds.		
1875	—	—	30,424,800
1880	54,691,300	17,513,300	72,204,600
1885	66,721,000	8,813,800	75,534,800
1890	68,538,700	6,898,900	75,437,600

It is interesting to follow the growth of the consumption of Russian coal from the different fields by the Russian railroads. This may be seen in the following table giving the data for the last ten years:

	1880.	1885.	1890.
	Pouds.		
Anthracite, Don coal fields	10,878,800	7,099,600	5,121,100
Don coal fields	22,239,600	34,332,800	39,762,600
Pod-Moscow	10,256,900	8,602,000	5,410,900
Poland	10,815,500	13,773,800	17,556,600
Urals	108,566	2,912,500	5,786,200
Caucasus	363,587	200	22,500

This table shows a rapid growth in the consumption of coal from the Don, Polish and Ural coal fields, and a reduction of one-half in the consumption of coal and anthracite from the Pod-Moscow basin.

The total consumption of coal in Russia has been approximately determined to be as follows:

	Pouds.
Metallurgical and metal industry	120,000,000
Railroads	76,000,000
Navy and other vessels	25,000,000
Gas works	15,000,000
Manufacture of textile fabrics	40,000,000
Sugar works	35,000,000
Other industries	80,000,000
Coal and other mines, salt works	15,000,000
House-warming and other purposes	55,000,000

The following two tables show: 1. the number of mines worked and the number of shafts in action; 2. the number of steam engines and their horse powers employed in the coal mines of the different coal fields during the last five years.

Coal fields.	1886.		1887.		1888.		1889.		1890.	
	Number of mines.	Number of shafts.	Number of mines.	Number of shafts.	Number of mines.	Number of shafts.	Number of mines.	Number of shafts.	Number of mines.	Number of shafts.
Don.	257	760	244	699	263	914	270	777	270	763
Polish.	27	54	27	58	20	56	20	59	20	52
Pod-Moscow . . .	10	34	10	56	12	39	12	36	12	46
Ural	5	14	6	17	7	20	8	21	8	19
Kirghiz steppes . .	2	4	5	16	8	13	9	37	8	24
Kievo-Elisavetgrad	1	3	4	5	7	3 7	1	3	1	3
Sakhalin.	1	3	1	3	1	3	1	3	1	3
Kusnetsk	2	6	2	6	2	6	2	6	2	7
Caucasus	2	4	5	16	8	13	8	31	7	20
Turkestan . . .	3	5	5	2 3	6	8	5	9	6	12
Total. .	310	887	309	881	327	1,082	337	982	336	949

Coal fields.	1886.		1887.		1888.		1889.		1890.	
	Steam engines.	H. P.	Steam engines.	H. P.	Steam engines.	H. P.	Steam engines.	H. P.	Steam engines.	H. P.
Don	148	3,352	158	3,553	186	4,038	221	5,171	228	5,856
Polish.	139	8,643	149	9,226	155	9,971	167	9,898	167	10,497
Pod-Moscow . . .	54	664	33	470	35	526	36	521	34	594
Ural	—6	100	5	91	5	91	8	161	9	241
Kirghiz steppes . .	—1	12	1	6	1	6	—	—	3	14
Kievo-Elisavetgrad .	—	—	1	10	1	10	1	10	1	10
Sakhalin.	—	—	—	—	—	—	—	—	—	—
Kusnetsk	1	14	1	14	1	14	1	14	2	19
Caucasus	—	—	—	—	—	—	—	—	—	—
Turkestan	—	—	—	—	—	—	—	—	—	—
Total. .	349	12,785	348	13,373	384	14,656	434	15,775	444	17,231

The accompanying table gives the number of men employed underground and at the mouths of the shafts in the different coal fields during the last three years.

Coal fields.	1888. Underground.	1888. Surface.	1888. Total.	1889. Underground.	1889. Surface.	1889. Total.	1890. Underground.	1890. Surface.	1890. Total.
Don	16,423	4,047	20,470	20,963	4,704	25,667	—	—	25,167
Polish	7,274	2,868	10,142	7,244	2,851	10,095	6,077	2,615	8,692
Pod-Moscow	1,915	1,007	2,922	2,141	988	3,129	1,733	719	2,452
Ural	1,284	1,427	2,711	1,713	1,223	2,936	1,176	1,250	2,426
Kirghiz steppes	206	—	206	202	—	202	125	22	147
Kievo-Elisavetgrad	85	—	85	40	13	53	21	7	28
Sakhalin	212	386	598	228	242	470	277	236	513
Kusnetsk	235	107	342	219	219	438	207	403	610
Caucasus	178	24	202	102	14	116	206	164	370
Turkestan	195	84	279	108	57	165	86	73	162
Total	28,007	9,950	37,957	32,960	10,311	43,271	—	—	40,571

L a comparison be made of the figures of these three tables and the production of coal in the different coal fields, it will immediately be seen that the Polish coal mines differ distinctly from the others in the vastness of their yield. As the Polish and Donets coal fields always very nearly equal each other in their yield a comparison will be made only of these two fields for the year 1890, when the yield of the former was 150,000,000 pouds, and of the latter, 183,000,000 pouds. The latter amount was furnished by 270 coal mines from 763 shafts, that is, each mine on the average yielded 678,000 pouds and each shaft 240,000 pouds. In Poland there were only 20 mines in work, with 52 shafts which gave a yield of 7,500,000 pouds from each mine, and 2,985,000 pouds from each shaft. Similarly a comparatively rare application of steam power is seen in the Donets coal fields where there were only 228 steam engines to 763 shafts, that is, less than one engine to three shafts, while in Poland there were 167 steam engines to 52 shafts, or more than three engines per shaft. And lastly with respect to the number of men employed, in the Polish mines the yield of coal per man is much greater than in the Donets district. This may also be ascribed to the larger application of steam power and to the thickness of the coal veins, which in the Donets coal fields rarely exceeds one sagene, while in Poland the chief vein, which gives nine-tenths of the entire production, is from four to six and more sagenes thick.

Passing now to the exportation and importation of coal it is seen that Russia, with an exceedingly limited export, receives a very considerable quantity from abroad, and that this importation is on the whole gradually increasing notwithstanding the growing home production. The following table shows the gradual progress of the Russian importation of coal.

Years.	Total importation of coal.	Average yearly importation of coal.
	Pouds.	
1866—1870	245,510,000	49,102,000
1871—1875	302,474,600	60,500,000
1876—1880	485,515,000	97,103,000
1881—1885	561,144,000	112,228,800
1886—1890	499,120,000	99,824,000

In this table the figures up to 1885 show the combined importation of coal and coke, but those for the past five years do not include coke. During these five years the importation of coke amounted to 49,334,500 pouds, or on the average, 9,867,000 pouds per year, so that the combined average importation of both coal and coke amounted to 109,691,000 pouds. As in Russia there are three chief regions of consumption, south Russia, Poland and the Baltic coasts, the first two of which being able to supply themselves with coal from the local coal fields, while the latter is necessarily obliged to consume foreign coal, it is important to know how the total importation of coal is distributed between these regions. During the last five years the distribution was as follows.

Importation.	1886.	1887.	1888.	1889.	1890.
			Pouds.		
		a. Coal.			
To White Sea ports	214,200	117,800	274,100	299,400	289,100
To Baltic ports	72,761,200	70,543,400	69,582,200	84,499,300	74,558,400
Across the western frontier	20,957,500	12,893,000	11,094,500	10,658,600	9,617,800
To Black Sea and Azov ports	13,080,000	3,822,400	15,095,300	18,416,100	9,478,500
Across Asiatic frontier	72,700	121,400	539,600	411,950	220,600
Total	107,085,600	86,998,000	96,585,700	114,285,350	94,164,400
		b. Coke.			
To White Sea ports	1,200	1,300	300	12,000	3,200
To Baltic ports	3,063,500	3,809,800	3,461,800	5,391,800	3,202,600
Across the western frontier	3,300,700	4,971,300	5,704,600	6,479,400	9,055,900
To Black Sea ports	34,400	—	625,100	140,600	27,000
Across Asiatic frontier	—	22,700	8,000	14,300	3,600
Total	6,399,800	8,805,100	9,799,800	12,037,600	12,292,300

While the importation of coal and coke through the Baltic ports remains nearly constant, that of both coal and coke to western Russia is subject to a considerable and at the same time somewhat constant variation. Although the importation of coal across the western frontier has fallen nearly one-half during the last five years owing to the growth of the production of the Polish coal fields yet the importation of coke has nearly tripled during the same period. This must be ascribed to the rapid growth of the production of pig iron in Poland for which coke is imported from Prussia and Austria, as

the Polish coal is non-coking. During the last five years the following countries were the chief exporters of coal to Russia.

Countries.	1886.	1887.	1888.	1889.	1890.
	Pouds.				
			a. Coal.		
Great Britain . . .	86,166,600	73,949,000	85,034,800	102,589,800	84,522,700
Germany	19,520,800	12,383,800	10,579,800	40,579,800	8,662,900
Austria	1,281,600	300,600	327,650	538,000	711,300
Norway and Sweden	—	271,600	450,400	492,200	21,100
Spain.	—	—	—	359,800	124,100
			b. Coke.		
Great Britain . . .	2,775,250	3,241,450	3,630,350	5,140,700	3,062,750
Germany	3,200,600	4,286,650	4,789,800	4,660,300	6,045,000
Austria	403,100	1,157,000	1,317,700	2,097,800	3,178,300
Holland.	20,850	78,100	54,000	138,900	—

The exportation of coal from Russia during the last five years is expressed by the following figures:

1886. . . .	150,000 pouds.
1887. . . .	192,000 »
1888. . . .	950,900 »
1889. . . .	880,900 »
1890. . . .	834,700 »

In order to protect the Russian coal industry from foreign competition during the last ten years the Government has found it necessary to place a duty upon foreign coal, and this duty has been gradually raised. Until the year 1884 all coal, with the exception of that passing through the Polish frontier, was imported free of duty. In 1882 the coal imported through the Polish frontier was subjected to a duty of one kopeck per poud instead of half a kopeck as before. In 1884 a duty was put upon the coal and coke imported through all the frontiers of Russia with the exception of the White Sea, namely: 1. the ports of Black Sea and Sea of Azov, 2 kopecks in gold per poud; 2. across the western frontier by land, one and one-half kopeck in gold per poud; 3. the ports of the Baltic, half a kopeck in gold per poud. In 1886 the duty upon coal imported through the ports of the Black Sea and Sea of Azov was raised to three kopecks; and in 1887 the duties upon coal and coke were distributed and altered as follows:

	Coal.	Coke.
Imported through ports of the Black Sea and Sea of Azov.	3 kopecks.	4½ kopecks.
Imported across the western frontier by land	2 »	3 »
Imported through ports of the Baltic.	1 »	1½ »

The customs tariff of 1891 did not introduce any changes in these duties, but in 1892 the duties on the coal and coke imported through the ports of the Black Sea and Sea of Azov were raised to four kopecks for coal, and six kopecks in gold for coke.

THE DONETS COAL FIELD.

This basin occupies the southern portion of the government of Kharkov, the eastern portion of the government of Ekaterinoslav and the western portion of the province of the Don Cossacks. It extends over an area of irregular form, lengthened in the direction from west to east, 320 versts long and 150 versts across. By its geological structure the whole area of the Donets coal field may be divided into three portions; the middle, and most extensive, consists entirely of strata of the carboniferous system; the eastern and western portions are covered by more recent strata amongst which those of the carboniferous system only appear in the form of separate islands. Surveys made in 1864 and 1869 showed that the carboniferous strata of the Donets basin cover an area of about 20,000 square versts. But it has been asserted by such authorities as Le Play, Helmersen and Guillaumen that the strata of the carboniferous system extend over an equal area beneath strata of the Permian, cretacious and tertiary systems, so that in all, the area occupied by the coal-bearing strata of the south of Russia may be taken as approximately forty thousand square versts. The superficial aspect of the district is hilly, intersected in different directions by deep ravines; on the average it is situated at an elevation of 460 feet above the level of the sea, although in many places it stands much higher.

The first record of the discovery of coal in the south of Russia belongs to the beginning of the eighteenth century at the time of Peter the Great's Azov campaign. A piece of coal was brought to the Emperor who being already acquainted with its use in Western Europe pronounced the famous words: "This mineral will be extremely valuable, if not to us, at all events to our descendants." At the close of the last century the Government endeavoured to apply the Donets coal to heating the Black sea fleet, and to transport it to the nearest ports. In 1797 the Lougansk Iron Works were built for satisfying the requirements of the Black sea fleet and to establish the manufacture of pig iron with local coal in the south of Russia. If these efforts were not crowned with success, at all events the surveys made between 1797 and 1806 brought many deposits of coal and iron ores to light, which subsequently aided the systematic investigation of the whole of the Donets coal basin.

One of the chief movers in starting the extraction of coal in the south of Russia was Count Vorontsov, then Govenor General of Novorossia and Bessarabia; and it was in his time that a geological survey of the Donets basin was begun. In 1827 Mr. E. Kovalevsky's report on the geological survey was published, and in it the Donets coal fields were for the first time called a vein, and its formation referred to the most ancient or carboniferous sandstone age. In 1835 scientific explorations of the coal veins were begun by mining engineers specially sent for the purpose by the Government. Soon afterwards a private individual appeared in aid of the Government, and in 1837 an expedition was sent by Anatole Demidov, to explore the mineral wealth of the south of Russia. In this expedition the Donets basin was explored by the French engineer Le Play, who in 1842 published his remarkable memoire on the Donets coal field, under the title "Voyage dans la Russie méridionale, par Le Play; Paris, 1842." In this memoire the strata of the Donets basin were for the first time scientifically classified into their

various systems. Le Play did not recognize the existence of strata belonging to the upper carboniferous system but referred the Donets coal-bearing strata to the lower carboniferous system, that is, to carboniferous limestone; and in the absence of fossil remains indicating the order of their stratification he divided them into eight separate groups. This want was soon satisfied by another foreign geologist, Murtcheson, who succeeded in classifying the Donets coal-bearing strata under the same three divisions as he established for the carboniferous limestone of central Russia, in consequence of which he referred the coal veins to the middle division. The Donets basin was subsequently the object of numerous private explorations which brought to light such stores of coal as had never been expected. In the western portion of the basin alone, in the government of Ekaterinoslav, the presence of forty-four workable veins was determined, having a total thickness of 112 feet and a store of 415 milliard pouds of coal at a depth of 100 sagenes. The eastern portion of the basin in the Don province, proved to be still richer in coal. These explorations elucidated the formation and structure of the coal-bearing strata and showed that they might be divided into three divisions as follows:

The lower division, corresponding to culm, containing veins of anthracite coal. The middle productive division, containing caking and coking coal. The upper productive division, containing gas and cannel coal. The rock strata, in which these three divisions occur, consist of sandstone, shale, limestone and intermediate formations.

The coal veins rarely exceed one sagene in thickness. It is remarked that those seams which are not more than three feet thick, generally consist of uniformly clean coal, while the thicker seams often exhibit interlayers of shale or sandstone. In the majority of cases the roof and floor of the coal seams consist of clay shale or sandstone.

The Donets coal field is remarkable not only for its vast extent but also for the great variety of coal it produces. It includes every quality, from soft coal to anthracite. The different varieties of coal are however far from occupying equal areas. Dry coals, burning with a long flame, are only met with in the north-eastern borders, at Zisichansk, and extend over a very limited area; the greasy, gas and smithy coals form a narrow zone between the dry and caking coals. The caking, giving coke suitable for metallurgical purposes, occurs in two separate areas of comparatively large extent; the semi-anthracites form a gradual transition from the caking coals to the anthracites, which cover the whole of the south-western portion of the Donets basin.

The dry coals are hewed in lumps but rapidly disintegrate in the air, and hence they cannot be stored for any length of time, nor be transported to any great distance. They also contain a considerable amount of ash and sulphur. The gas coals are greasy in appearance, are generally hewn into small lumps, but owing to their caking properties and cleaness they are also suitable for house fires. The caking coals are black, dull, small and are used both as fuel and for coke. They contain but little sulphur and ash. The semi-anthracites vary in appearance; some are pitchy, are cut into large lumps with small shining surfaces, but they rapidly disintegrate and burn with a long flame; others are black, with large shining surfaces and burn with a short flame, but owing to the presence of interlayers of clay schist and calc spar they decrepitate, and do not burn well in the fire. Lastly the anthracites are of a brilliant black color with a compact fracture; they are hewn into large, dense lumps, and burn without flame. The following table gives the average chemical composition of the five kinds of Donets coal.

	Volatile substances and water.	Carbon.	Sulphur.	Ash.	Coke.
GROUP I.					
DRY COALS					
with long flame	37·60—50·10	37·70—55·20	0·60—5·15	1·25—8·10	49·10—55·10
GROUP II.					
GREASY COALS					
a. with long flames, gas coals.	27·80—37·40	50·50—67·40	0·50—2·30	1·10 -7·00	58·30—70·40
b. with short flames, smithy coals	26·40—30·60	60·20—72·40	0·25—1·60	1·30—4·00	69·40 -72·90
GROUP III.					
GREASY COALS					
with short flames, coking coal	12·40 - 23·50	66·60—85·10	0·40—3·10	0·90—8·30	70·30—87·10
GROUP IV.					
Semi-anthracite	10·20—20·30	73·50—87·50	0·20—3·00	1·50—6·20	78·40—89·60
GROUP V.					
Anthracite.	4·20—11·40	85·40--91·00	0·60—2·90	2·00—9·00	90·70—95·80

For a long time the Donets coal was exclusively worked by small capitalists and it is only since the construction of railways in the south of Russia, calling forth an increased demand for coal, that the matter was taken up on a large scale and the veins worked in vast and well organized coal mines. At the present time the shafts in some mines are over a hundred sagenes deep. Fire damp has recently made its appearance in some mines in the Donets basin, and there have already been several explosions with loss of life. The accompanying table shows the gradual progress of the development of the Donets coal industry, giving the data for soft coal and anthracite separately.

Years.	Yield of bituminous.	Yield of anthracite.	Total.
	Pouds.		
1855	—	—	4,500,000
1860	2,005,000	4,004,000	6,009,000
1865	4,104,000	5,725,000	9,829.000
1870	2,629,900	13,017,400	15,647,300
1875	25,708,000	25,728,700	51,436,700
1880	57,086,100	29,261,200	86,347,300
1881	58,227,600	33,070,600	91,298,200
1882	73,066,200	33,184,000	106,250,200
1883	75,669,000	31,648,000	107,317,000
1884	70,626,800	30,918,000	101,544,800
1885	82,345,000	32,601,300	114,946,300
1886	95,876,500	32,778,000	128,654,500
1887	97,730,600	27,753,800	125,484,400
1888	105,230 300	31,529,400	136,759,700
1889	145,660,400	44,208,600	189,869,000
1890	146,766,100	36,482,700	183,248,800

Anterior to the Crimean campaign the yield of the Donets basin was in all, according to official data, about one million pouds of bituminous coal in the government of Ekaterinoslav, and slightly over three million pouds of anthracite from the Groushevsk mines in the province of the Don Cossacks. Out of this quantity about two million pouds were consumed in heating private and governmental buildings in the regions of Black and Azov seas, and on the steamers navigating the Black sea and the south Volga and even on the Caspian; the remainder was consumed in the locality. The coal was mainly used for smithies, for the Lougansk foundry works and the Slaviansk salt works. The anthracite was used by steamers and governmental buildings. The above table shows that up to 1875 the amount of anthracite raised constantly exceeded the yield of bituminous coal. The yield of anthracite then almost attained its full extent, due to the measures taken for its production in the province of the Don Cossacks. In 1856 the anthracite industry of the Don province was pronounced free, and the formation of companies for its exploitation was permitted. On March 8, 1864, an Imperial statute was formulated respecting the mining industry in the present province of the Don Cossacks by which all persons, without restriction of being of Cossack origin or not, were admitted to the mining industry of this district. Thanks to this law the production of anthracite began to develop rapidly, and in two years had risen from 3,600,000 pouds, 1864, to ten million pouds, 1866. To this period also belongs the construction of the first special coal railway in Russia, from the Groushevsk anthracite mines to the Cossack village of Aksaisk on the Don, 66 versts in length.

The year 1866 inaugurated the gradual construction of a whole network of railroads in the south of Russia, namely, the Koslov-Voronezh-Rostov (1868—1871); the Kursk-Kharkov-Azov (1869); the Kharkov-Nicolaev (1870—1878); the Konstantinovsk (1872); the Lozovo-Sevastopol (1873); Rostov-Vladikavkaz (1875); Fastovsk (1876); Donets Coal Railway (1878); Mariopol (1882), and Ekaterininsky (1884). The Kursk-Kharkov-Azov Railway, passing through the western portion of the Donets basin, including the richest coal deposits, was opened in 1869 along its entire length of 763 versts. This railway gave the possibility of finding a market for the Donets coal which up to that time had been exclusively transported by oxen, and could not therefore have an extensive sale. How great an influence this railroad had in developing the production of the Don coal field is seen from the fact that it rose from 2,250,000 pouds, extracted in 1862, to 47,000,000 pouds in 1879. Thus, it increased twenty-one times in the space of eleven years. The Koslov-Voronezh-Rostov Railway connected the anthracite mines of the eastern portion of the Donets basin with the general network of Russian railroads, thus giving the possibility of selling the anthracite in the interior of Russia. The Kharkov-Nicolaev and Lozovo-Sevastopol railroads opened out the Black sea ports to the Donets coal; and the Fastovsk railroad connected the Don basin with the rich region of the sugar industry. The Donets Railway, whose branch lines intersect the Donets basin in various directions, connected the Kursk-Kharkov-Azov with the Koslov-Voronezh-Rostov Railway and gave a free outlet to the coal from the mines lying between these two lines, and animated the coal industry of the district to a very great extent. The connection of the Donets basin with the rich iron ore deposits of the Krivoy-Rog by means of the Ekaterininsk Railway, which extended to the Kharkov-Nicolaev line, called forth the erection of extensive iron and steel works in the neighbourhood of this railway. And lastly the extension of the Konstantinovsk line to Mariopol on the Azov sea and the construction of a port for coasting vessels

with machinery for automatically loading the coal into them at Mariopol, opened out the most direct and easy routes between the coal mines and the sea, and gave the means of quick and cheap transportation to the ports of the Black sea, of which Odessa, formerly supplied by England exclusively, offered the greatest demand. The construction of the above mentioned railroads, the gradual growth of the industries of the south of Russia, the increasing traffic on the railways, necessitating an increased demand for fuel, the regulation of the transport of coal and of the railway tariffs, a protective duty upon the coal and coke imported to the ports of Black sea and Sea of Azov, all of these factors had an influence upon the rapid development of the coal industry of the Donets basin, which has doubled in its production during the last ten years. It must be remembered that the coal trade of the south of Russia is almost exclusively supported by markets situated at a distance, and that the local consumption is very inconsiderable. In general the coal industry would develop incomparatively quicker were it not that the coal has to be transported great distances by railways, which are not always to be depended upon for quick dispatch of their freight. As regards the distribution of the Donets coal between different classes of consumers, there are very accurate official data respecting the consumption of coal transported from the western portion of the Donets basin for the last ten years, but these data do not include anthracite.

Class of Consumers.	1880.	1885.	1890.
	Trucks *.		
Railroads	36,781	55,973	60,911
Black sea fleet	6	648	117
River and sea navigation	3,780	6,036	13,124
Gas works	585	775	2,994
Metallurgical works	326	190	34,745
Sugar works	11,420	15,362	19,274
Manufacturing industries and house heating	11,711	39,846	64,542
Total	64,549	118,830	195,707

Thus we see that during the last ten years the total consumption of coal has increased by three times. The separate items of the above table cannot be subject to comparison because the amount of coal consumed by the railroads and sugar works in 1890 was not normal, owing to their having laid in considerable stocks of coal for that year fearing a repetition of the coal crisis of 1888 to 1889. In 1889 the railroads were supplied with 84,426 trucks of coal and the sugar works with 30,640, that is, the former with 40 per cent, and the latter with 52 per cent above the demand in 1890. On the other hand, the newly erected metallurgical works in the south of Russia consumed a considerable amount of coal and coke. During the last two years the yield of coke in the Donets district was in 1889, 10,207,376 pouds and in 1890, 17,081,211 pouds.

* One truck contains 609 pouds.

In 1890 there were altogether 270 coal mines in work in the Donets basin; of this number 195 yielded anthracite and 75, bituminous coal. As the preceding table shows that in 1890 the yield of soft coal was four times greater than that of anthracite, it is evident that the latter was chiefly worked by small capitalists, although there are mines yielding more than four million pouds of anthracite; but on the other hand there are a number of mines with an output of less than 30,000 pouds. Among the coal mines proper there are some which give five, eight, fifteen and even twenty-two million pouds annually.

The Moscow Basin.

This coal region extends over the governments of Tver, Moscow, Kalouga, Tula, and part of the governments of Novgorod, Smolensk, Riazan, Vladimir and Tambov. This central field of carboniferous strata is six hundred versts long and over four hundred wide. To the north the carboniferous strata spreads out in a rather wide band across the governments of Olonets and Archangel to the White Sea. The coal bearing strata of the Pod-Moscow basin are chiefly limestone; the coal veins lie between limestone of the lower division and strata of the Devonian period. In some places limestone of the carboniferous system lies between the Devonian and the coal bearing strata.

The presence of coal in the Pod-Moscow basin was known at the close of the last century; the first veins were discovered in 1768, on the borders of the basin in the government of Novgorod, and in 1796 in the government of Riazan. The rapid extirpation of the forests in central Russia caused the Government to turn its attention to the coal veins of the Moscow basin, and to make repeated endeavours to establish the exploitation of coal there. In 1851 a third and detailed exploration was made of the coal veins in the government of Tula. This exploration was conducted by two parties, one geological and the other mining, which after two years of work came to the conclusion that the coal of the government of Tula was of unsatisfactory quality and occurred in the form of interrupted masses unsuitable for regular working. This opinion was retained until the close of the fifties when Count Bobrinsky, being in want of fuel for his sugar works, began to make explorations of this question on his Malevka estate in the government of Tula, where he discovered a vein of coal which proved to have a vast horizontal extension. The exploitation of this vein was begun and induced other landowners to make surveys which also led to satisfactory results and the opening out of fresh coal mines.

The rapid growth of the railway system in Central Russia, about 1865, called forth a more active exploitation of the coal in the government of Riazan and Tula. In general the growth of the coal industry in the Moscow basin is represented by the following data.

Years.	Yield of coal. Pouds.	Years.	Yield of coal. Pouds.
1860	631,250	1884	24,009,500
1865	1,371,300	1885	21,307,500
1870	5,078,500	1886	15,652,300
1875	23,658,600	1887	17,589,100
1880	25,117,800	1888	16,865,000
1881	23,426,200	1889	18,697,300
1882	24,400,300	1890	14,268,100
1883	22,731,500		

The decrease in the production of coal from the Moscow basin during recent years is due to the competition of the Donets coal, which is of far better quality, and also to the increased adoption of naphtha refuse in the place of Moscow coal and peat in the Moscow manufacturing district.

At the present time the presence of coal has been certified in over two hundred places in the Moscow basin, but only twelve mines are worked. This is due to the fact that only a few veins are of a workable character, and also to the fact that the coal is often of very poor quality and does not permit of being transported to any distance, or of being exposed to the atmosphere for any length of time; it often contains also a considerable amount of ash. This coal does not coke. Thus the Moscow coal is combustible, and of rather poor quality, which however is suitable for heating steam boilers and buildings and for making gas. The chief consumers of this coal are the railways of central Russia and certain local works. The chemical composition of the Moscow coal is as follows:

Carbon	from	24·5	to	50·8	per cent
Volatile matter .	»	24·1	»	49·1	» »
Moisture	»	3·1	»	15·9	» »
Ash	»	9·0	»	22·4	» »
Sulphur.	»	2·0	»	14·4	» »

The best kind of Moscow coal is the so-called boghead, which is distinguished for the large amount of hydrogen it contains, and the considerable quantity of gases it gives by dry distillation.

The Kiev-Elisavetgrad Basin.

Although veins of brown coal have long been known to exist in the neighbourhood of Kiev, the quality of the coal was too bad to be of much use. In 1860, thicker veins of brown coal were discovered on the Ekaterinopol Crown estate in the Zvenigorodsk district and on Count Bobrinsky's estate of Smela in the Cherkassk district of the government of Kiev. These veins are now being worked. Subsequently several other veins of brown coal were discovered along the Fastovsk Railway but none of these have been worked. Geological surveys have proved that the coal of the Kiev-Elisavetgrad basin belongs to the tertiary system and that the strata containing the brown coal extend to the government of Kherson, and also that the area over which new coal veins may be looked for, in the governments of Kiev and Kherson, extends over about five thousand square versts. The following table gives the production of the Kiev-Elisavetgrad basin since 1868.

Years.	Production of coal.	Years.	Production of coal.
	Pouds.		Pouds.
1868	103,000	1885	554,700
1875	1,093,000	1886	859,700
1880	534,400	1887	558,900
1881	584,200	1888	215,000
1882	656,600	1889	853,000
1883	571,600	1890	693,300
1884	635,000		

The Polish Basin.

This coal region is situated at the very south-western corner of Poland and embraces a portion of the Bendinsk district of the government of Petrokov and of the Olekoushsk district of the government of Kelets. From a physiographical point of view it forms a continuation of the so-called Polish-Silesian basin, whose western part lies within the limits of Prussia and southern part within those of Austria. The superficial aspect of the Polish basin is in intimate connection with its geological structure. In general the district is undulating, descending in a south-western direction, and in so doing presents a transition from the newer to the older strata. The strata of the carboniferous system come to the surface surrounded by trias, keiper, jurassic strata, and on the average rise to 900 feet above the level of the sea. The area of the entire Polish-Silesian basin, in which there is reason for supposing it to be a continuation of the upper coal-bearing formations of the carboniferous system, extends over about 5,800 square versts, of which four thousand are in Prussia, one thousand in Austria and about eight hundred in Poland. The portion upon which the presence of coal veins has been revealed by mining explorations covers an area of about 2,100 square versts of which about nine hundred are in Prussia, seven hundred in Austria and about five hundred in Poland.

In their petrographical relation the carboniferous strata of the actual Polish basin consists of sandstone and schist which frequently pass imperceptibly from one into the other. The carboniferous system of this district includes coal, iron ore, sandstone and fire clay, all of which are worked.

Paleontological data show that the entire Polish-Silesian basin may be divided as follows:

1. The upper productive division which includes the coal veins.
2. The lower division or "Culm" which does not contain coal and covers the first.

The upper division may in its turn be subdivided into, the upper and the lower. The upper subdivision is characterized by the considerable thickness of the coal veins; the lower, although it includes a considerable number of coal veins, does not present any of great thickness. The coal veins, which are known in Poland, chiefly belong to the upper subdivision.

From an industrial point of view the most important zone of carboniferous formation in the entire Polish-Silesian basin is that which extends into Prussia from Zabrzhe to Mislovitsy and farther to the east into Poland and to Austria on the south-east. The chief production of coal is centred within the limits of this zone.

The coal veins worked within this zone are divided into three groups: 1. The middle group including a thick vein, known as the Reden vein in Poland and the Sattel-Flötz in Germany; 2. The upper group of veins lying above the Reden; these veins are not so thick as the Reden, and the coal is of a different quality; 3. The third group of veins lies below the Reden and is also of less thickness. In Poland all the three groups are worked. The thickness of the veins and the quality of their coal is far from being constant throughout the entire range of the above mentioned zone. For instance, in Poland the Reden veins have an average thickness, from four to seven sagenes, but as it extends to the west this vein is divided by interlayers of dirt, first into two, then three, and lastly into four separate veins, each from one to four sagenes thick. The quality of the coal

also varies as the seam subdivides and thins out. At the western extremity near Zabrzhe in Prussia the Reden group of veins contains coking coal. At the same locality the lower veins of the upper group, lying above the Reden vein, contain gas coal, and it is only the coal of the uppermost veins that should be referred to the class of poor coals. Nearer to the Polish frontier the Reden veins are no longer coking but are still serviceable for the preparation of gas. Lastly in Poland the Reden and the overlying veins give neither coking nor gas coal. In Poland the number of upper veins overlying the Reden amounts to twelve, having a total thickness of nine sagenes. Here the average thickness of the Reden vein is from seven to ten sagenes. And lastly there are nine veins having a total thickness of about seven sagenes, underlying the Reden vein. All these veins have a common extension from the north-west to the south-east, and dip in a south-western direction. Outcrops of the Reden vein are known at a great distance. To the south in Poland, the Reden and the other coal veins crop out and form a basin filled with trias formations. Owing to the convolution of the entire series of the formations of the carboniferous system, the Reden vein is worked in different places at very different depths, from 35 to 120 sagenes, and at one point a new shaft has been sunk to a depth of 140 sagenes. The veins overlying the Reden are worked at a depth of 18 to 30 sagenes.

The work of exploitating the coal in Poland was up to recent times conducted on the same plan as in the neighbouring Russian Siberia, that is, by letting the roof fall in. But with this mode of working the far greater thickness of the Reden vein in Poland caused numerous accidents, while the impossibility of winning all the coal led to considerable waste. Moreover the disintegration of portions of the vein and the consequent self-combustion of the coal occasioned frequent fires in the mines, which sometimes continued for several years and necessitated such radical measures, as flooding whole groups of large coal mines. In consequence of this the Government recently turned particular attention to this matter and now the exploitation must be carried out according to Government regulations. By these regulations, those veins which are over two to three sagenes thick according to the local conditions, can only be worked by filling up the worked out spaces with goaf. Besides the frequent occurrence of fires, the Polish mines present another difficulty owing to the inconsiderable thickness of the superincumbant carboniferous formations in some localities, owing to which the mines are insufficiently protected from the bursting in of water, from the overlying strata of varigated sandstone, which is exceedingly watery. Due to the hardness of the coal in the veins, worked in Poland, it is everywhere blasted by gunpowder. This is possible, thanks to absence of oxyhydrogen gas.

As regards the deposite of brown coal occurring in the Bendinsk district of the government of Petrokov, they belong to the Keiper system and occur in veins about one sagene thick.

The chemical composition of the coal of the different groups is as follows.

	Volatile matter and water.	Carbon.	Ash.	Coke.
Reden vein	35·5—41·6	53·1—63·6	2·3—7·7	58·3—66·0
	24·5—25·6	70·5—71·8	3·7—4·0	—
Lower group of veins.	27·1—29·5	64·5	5·8—7·1	—

The exploitation of coal in Poland dates from the close of the eighteenth century, but only attained considerable dimensions after 1816, when the Polish zinc works were started. The production of the coal mines increased with the development of the zinc works, and with various fluctuations it reached a yield of ten million pouds a year, after 1860. The Polish insurrection in 1863 and the liberation of the mining population from obligatory labour in 1864 evinced an unfavourable influence on the Polish coal industry, but on the other hand there were many other factors which acted very beneficially on its development. The chief of these were the following: 1. The opening of a branch line of the Warsaw-Vienna Railway to the Prussian frontier; this line intersected the Polish coal basin and gave possibility of transporting the coals to Warsaw and other industrial centres; 2. The development of the metallurgical and manufacturing industries in the region of the Warsaw - Vienna Railway, with the almost exclusive employment of mineral fuel; 3. The growth of the application of coal to house-heating; 4. The publication of a new mining law for Poland in 1870; this law called forth the participation of exceedingly active private enterprise in the construction of new coal mines and in consequence a rapid rise in the production of coal since 1872; 5. The transference of the most important State coal mines into private hands; 6. The construction of the Ivangorod-Dombrovsk Railway during the beginning of 1880; this railway gave the possibility of supplying Polish coal not only to fresh markets within the limits of Poland itself, but also to the west and south-west of Russia, by a shorter route and without the reloading, which was formerly necessary owing to the difference between the guage of the Warsaw-Vienna Railway and that of all the other Russian roads.

The gradual growth of the Polish coal industry is seen in the following table.

Years.	Production of coal.	Production of brown coal.	Total.
	Pouds.		
1855	—	—	4,454,000
1860	—	—	10,787,900
1865	10,592,900	150,000	10,742,900
1870	19,580,600	498,800	20,079,400
1875	23,985,600	918,100	24 903,700
1880	77,395,900	1,053,000	78,448,900
1881	85,303,800	470,900	85,774,700
1882	83,665,000	665,700	84,330,700
1883	101,786,600	606,600	102,393,200
1884	102,816,700	656,600	103,473,300
1885	108,075,000	1,207,500	109,282,500
1886	118,605,900	1,451,600	120,057,500
1887	119,747,200	1,409,000	121,156,200
1888	145,918,400	1,438,700	147,357,100
1889	149,314,600	1,794,400	151,109,000
1890	149,586,700	1,205,800	150,792,500

At the present time there are twenty coal mines in Poland, one of which raises brown coal. The yearly output of the chief coal mines ranges from eleven to sixteen

million pouds, but one, the George pit, gave 34,436,000 pouds in 1890, from two shafts. These mines are furnished with powerful steam engines both for haulage and for pumping the water out of the mine. The majority of the mines have plants for sorting and some for washing the coal. They are nearly all connected by branch lines with the Warsaw-Vienna Railway and some of them also with the Ivangorod-Dombrovsk line. The Warsaw-Vienna Railway transports the largest amount of Poland coal; thus, in 1890 this line carried 93,814,600 pouds. The largest consumers within the region of this railway are the town of Lodz, with its manufacturing neighbourhoods, which consumed 30,613,000 pouds in 1890, and Warsaw, 26,000,000 pouds; then part of the coal, carried by the Warsaw-Vienna Railway, the most important route for the Polish coal field, is the Ivangorod-Dombrovsk Railway, which carried 18,980,600 pouds of coal in 1890; out of this quantity 5,376,900 pouds were transferred to the South-Western, Fastov, Koursk-Kiev, and Kharkov-Nikolaev railways. Taking the average results for recent years, the demand for Poland coal, including its consumption by railways, was distributed in the following manner:

	Pouds:
The region of the Warsaw-Vienna Railway	85,000,000
» » » » Ivangorod-Dombrovsk Railway	9,500,000
» » » » Vistula Railway	7,700,000
» » » » Warsaw-Terespolsk Railway	2,200,000
Consumption by the Lodz manufacturing district lines	500,000
Transferred to the South-Western, Fastov, Koursk-Kiev and Kharkov-Nikolaev railways	5,200,000
Transferred to the Moscow-Brest railways	1,200,000
» » » St.-Petersburg-Warsaw railways	2,000,000
	113,300,000

Moreover, about 40,000,000 pouds of coal are consumed in the neighbourhood of the pits, that is, in the district of Sosnovitsi, where a considerable amount is consumed by the metallurgical works.

THE URALS.

Carboniferous formations occur on both sides of the Urals. On the western side they form an almost uninterrupted band extending along the greater part of the strata. Besides this they also appear in separate patches generally among more recent formations. On the eastern side the carboniferous formations generally occur in small, narrow and interrupted bands and patches, sometimes jammed between massive, crystalline rocks. In their mode of stratification the coal measures of the western Urals present an almost entire similarity to those of the Moscow field, which similarity extends to the position of the coal veins, forming the basis of the system between the lower carboniferous limestone and the Devonian formations. As in the Moscow basin, carboniferous limestone in some places occurs above the latter, but beneath the coal measures. In its quality the coal of the western side of the Urals differs from that of the Moscow basin, being a true coal without any resemblance to the brown coals or boghead to which the Moscow coals more or less approximate. The exploitation of coal on the western side of the Urals is concentrated in a small area to the north, where the thickness of

the coal veins varies between a half and two and a half sagenes. The coal is poor and in some rare cases after being washed gives a caking coke.

The carboniferous formations of the eastern side of the Urals are distinguished for their comparative complexity and the originality of the upper division of the system. The lower division offers an almost perfect resemblance to the corresponding division of the western side and of the Moscow basin, being composed of lower carboniferous limestone and an underlying strata of coal measures stratified directly on Devonian formations. The most important coal-bearing area on the eastern side of the Urals extends for a distance of about a hundred versts in a southern direction. In this band may be distinguished the northern portion containing poor soft coal and anthracite, and the southern portion containing coking coal. Besides this there are areas where graphite is found with anthracite and where beds of graphite occur alone.

Although the exploitation of coal in the Urals was first, from 1851 to 1860, exclusively conducted on the eastern side, where the presence of coal of good quality has recently been certified, nevertheless at the present time the working of coal is almost entirely centred in the northern portion of the western side of the Urals. The following table shows the progress of the exploitation of coal here since 1855.

Years.	Yield of coal. Pouds.	Years.	Yield of coal. Pouds.
1855	440,000	1883	7,671,000
1860	408,000	1884	7,723,000
1865	766,200	1885	10,875,400
1870	387,400	1886	12,107,000
1875	1,278,900	1887	9,972,100
1880	7,217,400	1888	12,757,100
1881	10,031,800	1889	16,040,000
1882	12,253,400	1890	15,223,600

Up to 1870 the yield of coal was subject to repeated fluctuations owing to various external conditions. For instance, in 1864 more than a million pouds of coal were raised owing to the temporary transfer of the Vsevolozhsk coal mine to a private company, which supplied coal during that year to the steamers navigating the Volga, Kama and Oka. It was only in 1871 that the exploitation of coal became more active and regular in this district, and it received a great impetus in 1879 when a branch line of the Ural Railway was constructed intersecting the coal district of the western side of the Urals and extending to the banks of the river Kama.

Nearly all the coal raised in 1890 was obtained from four coal mines on the western side of the Urals. The Ural coal goes to the railways, local metallurgical and salt works, and a small quantity is transported down the Kama. The production of coke in the Urals during the last two years was in 1889, 589,700 pouds; and in 1890, 572,800 pouds. These figures show the small application of the Ural coal to metallurgical operations.

In 1875 coal was also discovered and explored in the government of Olonets on the north-western shores of lake Onega. In its composition this coal resembles anthracite, but owing to its mode of occurrence it does not deserve serious attention.

The coal fields of Asiatic Russia.

The presence of coal is known both on the northern and southern declivities of the Caucasus. Professor Abikh has shown that the coal veins on the northern side of the Caucasus lie on two levels and occur throughout the area of extension of the sandstones of the middle division of the jurassic system. Coal has here been worked since 1846 on the banks of the river Kuban, where it occurs in thin veins. The Kuban coal is black, rather bright and hard; it frequently contains pyrites and interlayers of gypsum, and also large nodules of spherosiderite. It burns with a bright flame and gives a caking coke. Besides the coal of the northern side of the Caucasus, deposits of a combustible shale, also belonging to the jurassic system, are worked in the province of Daghestan.

On the southern side of the Caucasus, coal is exploited in the government of Koutais at Tkvibula, 45 versts to the north of the town of Koutais. These coal veins are famous for their great thickness. The coal here occurs in several veins, lying one above the other and having a total thickness of seven sagenes. The property of the coal varies greatly in the different veins both in its external appearance and in chemical composition. The coal fields in the neighbourhood of Koutais also belong to the lower jurassic period. In 1890 two mines were worked on the Tkvibula coal deposit, and 457,500 pouds of coal were raised.

The Western Siberian Fields.

The most important coal field in this region is that of Kusnetsk situated in the south-eastern corner of the government of Tomsk, between the mountain chains, Salairsk and Altai. This coal field presents a vast basin divided into two parts along its length by the river Tom. It is 420 versts wide and 105 versts long, or about forty-four thousand square versts in area. This coal basin, which is one of the most vast in the world, contains many thick veins of excellent coal. The geological formations of the district belong to the post-tertiary, devonian and carboniferous periods. The coal measures belong to the last mentioned age.

Explorations conducted at different periods have shown that in many parts of the Kusnetsk basin there exist vast series of coal veins, varying in thickness from three feet to over six sagenes. It has been estimated that the store of coal in this field amounts to millards of pouds. The presence of coal in the neighbourhood of the town of Kusnetsk was already known at the beginning of the last century. At the present time only two mines are worked, which in 1890 gave an output of 1,051,540 pouds of coal. The oldest of these mines the Bachatsk, works a vein which varies in thickness, and in some places attains 25 sagenes; the quality of the coal also varies in different parts of the vein. In the middle portion the coal is dry, dense, dull, does not coke and burns almost without flame. In the upper and lower portions the coal is semi-greasy and greasy, friable, bright, burns with a flame and gives a good caking coke. In the Kolchoughin mine four veins are known, varying between six feet and two sagenes in

thickness, and lying almost horizontally. This coal gives a caking coke and does not contain more than 2 per cent of ash. The coal extracted in the Kusnetsk basin is chiefly used in the metallurgical industries of the Altai district. During the last two years the production of coke in the Kusnetsk basin was in 1889, 310,700 pouds, and in 1890, 412,700 pouds.

Coal veins are known in various parts of the Kirghiz steppes where they were first discovered in 1838. Different coal veins have been worked here at various times but all the workings were surface mines, and detailed explorations were nowhere made, nor the store of coal determined. According to the testimony of persons who have made geological surveys in the Kirghiz steppes the coal measures occur exclusively in strata of the carboniferous system. The coal of this district varies extremely in quality, some kinds giving a caking coke of good quality. In 1890 there were eight mines in work, yielding 62,500 pouds of common coal, 64,200 pouds of brown coal and 30,000 pouds of combustible shale.

In Eastern Siberia, coal veins have been discovered in different localities, in the governments of Yenisseisk and Irkutsk, in the Zaibaikal, Amour and seacoast provinces, and also in Kamchatka. Those of the seacoast provinces are most important and are the only ones which have been exploited. The Island of Sakhalin, which forms, as it were, a perfectly separate formation from the continent, is distinguished for the richness of its carboniferous formations. Thanks to surveys first made in 1851 a whole series of coal deposits was discovered extending from the northern extremity of the island along the western coast to its southern extremity for a distance of 950 versts, and also on the eastern shores and interior of the island. The extent of the coal veins, containing very good quality coal, is especially remarkable in the central portion of the western coast.

Notwithstanding the fact that the coal here lies in strata of the tertiary system, it is, as for instance at Doué where the coal is exclusively worked, of excellent quality and does not cede to the best sorts of Welsh coal. It contains from 74 to 84 per cent of carbon, a very small amount of ash and sulphur, and gives 60 per cent of clean metallic coke. The coal veins of the island of Sakhalin rarely exceed three feet in thickness, but they are easily worked by levels driven to the coal itself, which crops out along the steep seashore. The coal is supplied to the Russian fleet in the Pacific ocean and also to foreign commercial and war vessels, and the yield corresponds to the above demand.

As however the coal mines of the island of Sakhalin are at a great distance from Vladivostok, the chief port for the Russian Pacific fleet, and as coal veins have been discovered along the entire southern portion of the seacoast province from the bay of St. Olga to the very frontier of Corea, not only along the entire coast, but also in the interior, the Russian Government started a detailed exploration of the whole of the so-called South-Ousourisk region in 1886. In some places the coal veins have been worked since the beginning of the sixties. The most favourable and the richest of all these coal veins is situated on the river Souchan at a distance of 45 versts from the junction of this river and the Gulf of America. The coal veins here vary between three and seven feet in thickness and consist partly of caking and coking coal, and partly of a smokeless coal, resembling the Cardiff coal.

The absence of fuel in the Turkestan provinces induced the Government to take

measures for the exploration and survey of the coal deposits, said to exist in various parts of the country. These explorations resulted in the discovery of coal veins in different localities, some of which are now under exploitation. In the Syr-Daria province the presence of coal in the Karatau mountains became known after the first appearance of the Russian troops in that country, although the natives knew of the existence of this fuel. Preliminary explorations of these coal veins, prospecting for fresh measures, and their ultimate exploitation were undertaken in view of the possibility of furnishing the flottilia of the Sea of Aral with coal. Coal is worked in the neighbourhood of Chemkend, Tashkend and Hodgend, where some of the veins are as much as 2·5 sagenes thick. Sometimes series of coal veins, overlying each other, are met with. In 1890 there were six mines in operation in Turkestan, which gave a total output of 300,900 pouds of brown coal.

In conclusion the two accompanying tables give the chemical composition of the coal from the various regions of Asiatic Russia, and the production of those regions in pouds.

	Volatile matter.	Carbon.	Ash.
	Per cents.		
Caucasus, Kouban	37 —43	51·4—58·9	3·1— 5·6
» Tkviboulsk	37·9—43·0	39·1—55·5	2 —23·0
Kouznetsk basin	17·7—25·8	67·8—74·7	2 — 8·0
Sakhalin	26·3—30·3	53·4—68·0	2 —10·0
Kirghiz steppes	10 —42·0	27·5—64·4	4 —25·0
Turkestan	34 —40·0	55·3—56·8	2 —10·0

Years.	Kousnetsk basin.	Kirghiz steppes.	Seacoast provinces, Island of Sakhalin.	Turkestan.	Caucasus.
1860	55,000	185,100	133,000	—	100,000
1865	267,200	202,200	8,400	—	145,000
1870	350,000	477,900	123,200	75,000	197,900
1875	256,450	832,500	95,900	415,000	377,100
1880	484,650	1,240,000	501,900	305,200	387,300
1881	487,100	1,051,100	317,500	—	218,200
1882	422,300	1,064,900	707,200	—	108,000
1883	370,400	1,269,700	371,250	—	102,600
1884	542,200	1,516,800	424,000	—	52,600
1885	795,400	1,635,600	549,900	417,500	213,000
1886	873,000	306,600	409,800	340,500	133,000
1887	807,800	72,500	556,300	365,700	215,700
1888	1,010,400	91,700	600,300	426,100	511,400
1889	895,500	174,700	650,200	423,200	667,000
1890	1,051,500	126,700	892,500	300,900	604,700

SALT.

In Russia there are all the three sorts of salt, namely, 1. rock salt, 2. salt lakes, 3. salt springs; all of which are distinguished for their richness. (See map of the regions of salt production).

I. Rock salt is known in the following localities:

1. The Ilets deposit of rock salt is situated about 70 versts to the south of Orenburg and is one of the largest in the world. Surveys made here have shown that the salt occurs in an immense bed, the limits of which have not been accurately determined either in a vertical or horizontal direction. It is only known that the salt lies in a continous mass over an area of more than three square versts, for a depth of over 65 sagenes, and that the store of salt contained in this area is determined to be over fifteen milliard pouds. The Ilets salt is also unrivalled for its purity. The whole bed is pure throughout, with only three thin interlayers of red clay and gypsum. This deposit belongs to the State and is rented out to private individuals.

2. The salt deposits of the mountain of Chapchachi is situated in the government of Astrakhan, at a distance of about 90 versts to the east of the Volga. This deposit consists of a continuous bed, extending for a distance of about three versts with an average breadth of about one verst. Its thickness has not yet been accurately determined but it is not less than 42 sagenes, to which depth borings have already been made.

3. The Bakhmout or Briansk salt beds in the government of Ekaterinoslav, were only discovered about fifteen years ago. The idea of seeking salt in this locality arose from the presence of two salt springs, near the towns of Bakhmout and Slaviansk, situated at a distance of about forty versts from each other. But the actual likelihood of the occurrence of rock salt in the southern portion of the government of Kharkov and the northern portion of that of Ekaterinoslav, was first promulgated in 1841 by Le Play, after his exploration of the Donets coal basin. And in 1870 detailed geological surveys of the country between Bakhmout and Slaviansk fully confirmed this supposition. On the basis of these data, two bore-holes were sunk by private individuals near these towns, with the result that rock salt was actually discovered.

In 1876 the Government sank two holes, one near the village of Briantsevka about 10 versts from Bakhmout. This hole encountered the first bed of salt, 4·5 feet thick, at a depth of forty sagenes, and then another bed, 17 feet thick, at a depth of 46 sagenes. The boring was continued, to a depth of 109 sagenes, and passed through seven more layers of salt, in the last of which it was stopped before having passed through its entire thickness; altogether 49 sagenes of pure salt were bored. If this thickness of the beds be compared with the area covered by the Slaviansk-Bakhmout basin, it will be readily understood what an importance this discovery had for not only the south but the whole of Russia.

4. In the Caucasus, rock salt is worked in the government of Erivan, namely at the Koulpin, Nakhichevan and Soustin deposits, and also in the province of Kars at the Kaghyzman and Olitinsk deposits.

5. In the Transcaspian province a bed of rock salt is known in the neighbourhood of the gulf of Krasnovodsk. This bed was originally the now dried up lake of Karababa. The exploitation of this deposit is carried on irregularly.

II. In Russia there are brine evaporating works in the following localities:

1. In the government of Perm there are saltworks at a distance of about 400 versts above the town of Perm up the river Kama. These are the Ousolsk, Lenvensk, Dedukhinsk, Beresinsk and Solikamsk works.

2. In the government of Archangel salt is extracted both from brine and from the water of the White sea.

3. In the government of Vologda salt is extracted at three works, the Ledensk, Totemsk and Seregovsk works.

4. In the government of Nizhni-Novgorod brines are known near the town of Balakhna where there are now eight salt works in action.

5. In the government of Kharkov there are over twenty salt works, in the town of Slaviansk.

6. In the government of Ekaterinoslav there are works in the town of Bakhmout.

7. In the government of Warsaw, the Tsekhotsinsk Salt Works are situated close to the Prussian frontier.

8. In eastern Siberia there are ten salt works, four of which are situated in the government of Yenissei, three in the government of Irkutsk, two in the province of Baikal and one in the province of Yakutsk.

III. In Russia, salt lakes are very widely distributed and occur in numberless quantities.

1. The government of Astrakhan, which forms the comparatively lower portion of the great Aral-Caspian plane, abounds in salt lakes and marshes. The chief of the salt lakes is the Elton situated on the left side of the Volga at a distance of about three hundred versts from the town of Saratov. This lake is perhaps the richest of all the deposits of salt yet known. It covers an area of over two hundred square versts. The bottom of the lake is covered throughout with a vast layer of salt, whose thickness however has not yet been determined. The inexhaustibility of the stores of salt in this lake is already proved by the fact that during the space of 150 years it has yielded over 550 million pouds of salt without leaving any traces to show that any such amount has been extracted. In the Baskounchak lake, situated at the foot of Mount Bogdo, fifty versts to the east of the Volga, the bottom is also covered with a rich layer of salt. The area of the lake is about 110 versts. Investigations made at a depth of 25 sagenes at the bottom of the lake, showed the existence of three layers of salt, the upper of which, now worked, is from three to four sagenes thick, the second is one sagene, and the third was explored for five sagenes without passing entirely through it. The upper layer alone is estimated to contain forty-five milliard pouds of salt. A special railway line has been constructed for carrying the salt from the Baskounchak lake to the Volga, thanks to which the yield has been greatly developed. The salt extracted from this lake is very pure. Besides the Elton and Baskounchask lakes, the government of Astrakhan includes as many as seven hundred salt lakes, and up to one thousand two hundred salt marshes.

2. The salt lakes occurring in the Tauride government, are known under the common term of the Crimean lakes, and according to their geographical position, may be divided into the internal, lying in the Crimean peninsula itself, and the external, which occur in the northern portion of the government, in the Dnieper and Melitopol districts. All the Crimean lakes lie in proximity to the seashore, from which

they are separated by narrow stretches of sand. The brine of these lakes only reaches saturation in the summer, in specially constructed basins where the salt is deposited in layers several inches thick. The extent of the deposit of salt in these basins is entirely dependent upon meteorological conditions; thus during a hot summer the yield of salt is far greater than during a rainy season, when the process of deposition is much slower. Hence it will be understood that the success of the Crimean salt industry is greatly dependent upon chance, and that the lakes differ essentially in many respects from those in the government of Astrakhan.

3. In the government of Kherson the Kouyalnitsko-Hadgibeisk salt workings are situated near Odessa on the Kouyalnitsk liman.

4. In the province of the Don Cossacks is the Manych salt lake.

5. In the government of Stavropol is the Chalginsk self-depositing lake and on the borders of the government of Astrakhan, the Mozharsk and Gaidouksk lakes.

6. In the Caucasus there are salt lakes in the governments of Baku, Daghestan and Kouban.

7. In Asiatic Russia salt lakes are under exploitation in the provinces of Tourgaisk, Semipalatinsk, Yakutsk and Baikal, in the government of Tomsk, and also in the Transcaspian and Fergan provinces.

From the above it will be seen that Russia is in general very rich in salt, and would be able not only to amply supply itself but also to furnish other countries. But the geographical distribution of its stores is such that the chief natural sources mainly lie in the southern, eastern and north-eastern limits of European Russia, which until recently had no regular means of communication. This is the chief reason of the comparative high price of salt at the points of its consumption, although it is extremely cheap in the neighbourhood of its extraction. Under such conditions the growth of the demand for salt has up to very recently made little or no progress and some governments, namely the western and north-western, were obliged chiefly to consume foreign salt.

The furnishing of the Empire with salt was always a subject of special care to the Government. Up to 1862 a particular so-called monopoly system was in vogue. The Government, as the proprietor of the chief salt deposits and sources in the Empire, extracted the salt and sold it from its storehouses. The salt extracted from private sources, could be either sold by the proprietor, to the State at a fixed price, or to private individuals. But in the latter case a poudal tribute had to be paid to the State, the extent of which was determined annually. The deficiencies of this system made the Government renounce keeping the chief salt operations in its hands, and in 1862 the excise system was introduced. The Government gradually ceased its salt operations and handed over the State salt deposits to be rented and worked by private individuals. The salt extracted by them, on both private and State property, was subject to a tax, from which however the salt employed in feeding cattle and in the technical and manufacturing industries was exempt.

Salt imported was subjected to a duty of 38.5 kopecks per poud. With the introduction of the excise system upon salt, the private industry began to develop rapidly, so that the supply for the people was accomplished by a method of free trade throughout the Empire. The revenue brought to the Government by the excise dues upon home production of salt in some years exceeded ten million roubles. However, on January 1, 1881, the Government, wishing to aid the poorer classes in obtaining an object of first necessity and to develop the breeding of cattle, the fish trade and certain

branches of the manufacturing industries together with the improvement of agriculture, abolished the excise system entirely and lowered the duty upon salt imported to twenty kopecks a poud. This measure gave a great impetus to the growth of the salt industry in Russia. Since the abolishment of the excise system the production of salt has fluctuated in the manner shown by the accompanying table.

Years.	Rock salt.	Lake salt.	Evaporated salt.	Total.
	P o u d s.			
1881	4,200,700	29,713,300	16,820,300	50,734,300
1882	5,538,900	79,059,300	17,171,400	101,769,600
1883	7,301,800	44,173,000	17,997,400	69,472,200
1884	9,613,500	32,724,800	20,163,000	62,501,300
1885	11,155,000	36,078,300	21,947,000	69,180,400
1886	14,045.800	38,289,500	20,730,700	73,066,000
1887	15,950,800	37,148,300	17,517,000	70,616,100
1888	13,978,600	33,646,200	20,326,300	67,951,000
1889	14,704,900	47,678,600	22,738,700	85,122,200
1890	13.213,000	47,540,800	24,103,400	84,857,200

It is interesting to compare the present yield of salt with that of thirty years ago, before the introduction of the excise system. In 1860 the production of salt was as follows: rock salt 1,352,200 pouds, lake salt 17,157,200 pouds, evaporated salt 7,723,200 pouds, in all 26,232,600 pouds. Thus, between 1860 and 1890 the greatest increase observed in the yield of rock salt is 880 per cent; in the yield of evaporated salt, 212 per cent, and in that of lake salt, 175 per cent, while in general the total production has increased by 234 per cent during thirty years. During the last ten years, that is, since the abandonment of the excise system, after a considerable increase followed by a considerable fall in the price of salt in 1882, the production, especially of lake salt, decreased greatly. Since 1883, however, the growth of the output has proceeded far more uniformly.

From this general description of the salt industry of Russia a review of the chief deposits and sources, and of the markets at their disposal, may be given.

It has already been said that lake Elton is the richest of all the salt lakes of the government of Astrakhan. The extraction of salt from this lake has been carried on from ancient times on a very great scale, but the yield of salt has fallen with the development of the exploitation of the Baskounchak lake, which owing to its shorter distance, fifty versts, from the Volga, and its connection with this main water way of Russia by a railway, is now worked in preference to the other Astrakhan lakes. In 1866 lake Elton alone yielded 5,842,800 pouds, out of 9,146,000 pouds of salt extracted in the government of Astrakhan, while no salt at all was then extracted from lake Baskounchak. In 1870, lake Elton gave 1,015,400 pouds and lake Baskounchak, 1,279,000 pouds, however after a space of ten years, in 1880, only 595,600 pouds of salt were extracted from lake Elton and the exploitation of salt from lake Baskounchak had risen to 10,093,000 pouds. In 1882 the extraction of salt from lake Elton ceased entirely, while in 1890 the yield of lake

Baskounchak amounted to 12,800,000 pouds, and in 1889 it equalled 13,756,700 pouds. In general, in 1890 the salt lakes of the government of Astrakhan yielded 16,866,500 pouds of salt, although there had been years, for instance 1882, when the production was a little under twenty-six million pouds. A large proportion of the salt extracted from the Astrakhan lakes is consumed by the local fish industries of the Volga and Caspian Sea, where herring and salmon are caught in large quantities, and preserved chiefly with Baskounchak salt, while the cheaper kinds of fish are cured with the less pure salt of other lakes. The Astrakhan salt is also transported up the Volga, whence it is carried by rail into the central governments of Russia, as far as those points were it encounters the competition of the Perm, Bakhmout and Crimean salts.

Although the Crimean industry does not include such rich sources of salt as the Elton and Baskounchak lakes, yet its total yield is also considerable. Owing to the insufficient concentration of the lakes of southern Russia, the local salt workers are obliged to expend more labour and capital in exploiting the salt, and to construct artificial salt depositing basins for which there is no necessity in Astrakhan. The Government, which owns a considerable number of the Crimean salt lakes, leases them out at a poudal royalty varying between one and four kopecks. The most productive of all the Crimean lakes are those of Saksk and Sassyk-Sivashsk belonging to the Government. In 1890 the former yielded 3,455,000 pouds and the latter, 1,779,000 pouds. Of the private lakes the following are the most important: the Crim-Eliysk, yielding 2,026,000 pouds and the Chongarsk, 3,600,000 pouds. Altogether in 1890 the Crimean lakes yielded 23,519.800 pouds of salt, while those of the governments of Kherson and Bessarabia gave 1,708,800 pouds of self-deposited salt.

The salt extracted from these lakes is consumed in the south of Russia, where the people have been long accustomed to use self-deposited salt in preference to the rock salt of the Bakhmout basins, which has, however, barred the transport of Crimean salt to the interior of Russia. The competition of the Slaviansk-Bakhmout basin obliged the Crimean salt workers to seek fresh markets for their salt, and therefore they took advantage of the cheap sea freights and began to transport a portion of it by water from the Black sea to the ports of the Baltic, where the Crimean salt has supplanted the foreign product. The amount of salt brought by this route to St. Petersburg, Reval, Riga and Libau amounts to four million pouds. The Crimean salt is transported by rail from the Baltic ports towards the regions supplied with Donets salt. The self-deposited salt extracted in the Don province, Urals, Tourgai and Transcaspian and Fergan provinces, and also in various parts of the Caucasus and Siberia, has only a local importance.

Next to the lake salt, the largest yield falls to the evaporated salt, obtained by means of bore-holes, from which brine of the strength of 12 to 26° Baumé is pumped and evaporated. Owing to the cheapness of wood fuel this mode of extraction is more advantageous than the mining of rock salt from beds lying at a great depth. The most favourable combination of the necessary conditions for this process is found in the government of Perm where it has been practised since the middle of the sixteenth century. The brine is here pumped from a depth of 30 to 105 sagenes. In Count Strogonov's works, eleven beds of salt having a total thickness of 21 sagenes were encountered in sinking a bore-hole to a depth of 105 sagenes. Altogether in 1890 the Perm salt industry yielded 17,981,000 pouds of evaporated salt, the brine being obtained from 66 bore-holes and wells. The salt produced at the Perm evaporating works, besides going to the north,

penetrates far into the interior, thanks to the cheap water route along the Kama and Volga and their tributaries.

Second to the government of Perm, the evaporation of brine is carried on to a large extent in the governments of Kharkov and Ekaterinoslav, in the Saviansk-Bakhmout salt basin, where in 1890 there were twenty-one salt works at Slaviansk and one at Bakhmout. All these works are situated close to the Donets coal basin and therefore enjoy the advantage of cheap mineral fuel. The brine which is pumped varies in strength, but is chiefly between 22 and 23° Baumé. In 1890, 4,990,400 pouds of salt were produced at these works. Besides having a local demand this salt is consumed in the central and northern governments of Russia. The remaining evaporating works of European Russia and Siberia yield inconsiderable quantities of salt and have only an exclusively local importance.

As has been already remarked the deposits of rock salt in Russia are of enormous extent, but for various local reasons their exploitation has not yet obtained large dimensions, although during the last ten years the production has risen somewhat rapidly. In 1890, eighty-one per cent, or 10,789,900 pouds, of the total yield of rock salt, fell to the Bakhmout salt basin, where there are now altogether four mines, two of them having a total output of 7,500,000 pouds, belonging to a French company, and one to a Dutch company. The Bakhmout salt is distributed in all directions, except to the south, where it rapidly meets the competition of the Crimean salt. But it especially finds a market in the western zone of Russia and in Poland, where the inhabitants have long been accustomed to use rock salt, which was at first obtained from Velichki in Austria and afterwards also from Prussia where a large deposit of rock salt was discovered at Inovratslavel near the Russian frontier. Messrs. Lubimov & Solvey have recently constructed soda works near the Bakhmout salt mines, for treating the local material. In 1890, the Ilets rock salt mine in the government of Orenburg yielded 1,243,600 pouds and in the Caucasus three mines in the government of Erivan gave 784,300 pouds, and two in the province of Kars, 395,200 pouds of rock salt. The salt of these deposits is consumed locally.

In 1890 the total amount of salt consumed in Russia was 85,450,000 pouds which, taking the population as 117 millions, equals 29 pounds per capita. In 1890, nineteen thousand men were employed in the extraction of salt in Russia.

And now it remains to cite the data for the importation of salt from abroad. The following table shows the variation of the import of foreign salt into European Russia during the last ten years.

Years.	Import of salt. Pouds.	Years.	Import of salt. Pouds.
1881	11,368,800	1886	1,202,100
1882	10,290,700	1887	478,700
1883	9,469,900	1888	689,200
1884	4,566,300	1889	1,400,900
1885	2,147,100	1890	1,049,500

The following table, showing the gradual decrease of the importation of foreign salt to the Baltic ports and Western frontier during the last seven years, will illustrate what

was said above respecting the gradual spread of the salt industry, and chiefly of the Bakhmout district, towards the western parts of the Empire, and also respecting the carriage of Crimean salt by sea to the ports of the Baltic.

Import of salt.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
To Baltic ports	1,376,300	191,500	162,800	88,900	102,400	99,500	146,300
Across the western frontier by land	3,032,500	1,724,500	918,200	332,600	503,200	1,177,800	714,300

This salt was chiefly supplied by the following countries and in amounts as enumerated below.

Countries.	Importation of Salt.						
	1884.	1885.	1886.	1887.	1888.	1889.	1890.
Great Britain	1,191,900	462,500	235,600	116,600	164,200	147,400	181,400
Germany	1,890,600	904,500	517,100	129,500	291,500	990,400	618,700
Austro-Hungary	780,400	553,800	313,600	98,000	89,000	129,200	112,600
Roumania	—	148,600	124,800	118,800	130,600	123,200	119,300
France	—	7,700	7,500	—	6,300	4,000	—

According to the customs tariff of 1891 the following duties were placed upon the imported salt:

1. By sea and by land, with the exception of those localities mentioned in the following clause, 20 kopecks per poud.

2. To the ports of the government of Archangel, 10 kopecks per poud. According to the same tariff the importation of salt for curing fish is allowed duty free, on the Mourman coasts of the government of Archangel.

Besides common salt, glauber salt to the amount of about half a million pouds, is extracted from several lakes in the Caucasus and in western Siberia.

Naphtha.

Russia possesses numerous, and some of the richest, naphtha springs in the world and indeed the naphtha industry is one of the most important of all the mining industries of Russia. The naphtha deposits of Russia occur either in disconnected, isolated plots or else cover considerable and continuous areas extending over a large surface. The first category includes the deposits lying along the river Ukhta in the government of Archangel, and the Volga and Soka in the government of Samara, also in the southern portion of the government of Kelets, in the provinces of Ural and Turgai, in Turkestan and on the island of Sakhalin. All these localities have been but little explored, and not worked at all, or else worked only temporarily as an experiment.

The chief wealth of Russia in naphtha is concentrated within a vast area along the northern and southern declivities of the Caucasian range. Natural springs of naphtha, bitumenous masses, the evolution of gases and other indubitable signs of the presence

of vast accumulations of naphtha are met with over the whole area from the north-west to the south-east, starting from the peninsula of Kerch. Springs of naphtha are particularly abundant along the extremities of the hills, forerunning the Caucasian mountains. Thus naphtha is met with over the whole of the isthmus of Taman and in the valley of the Kouban river and its left tributaries along the northern declivity of the Caucasian mountains for a distance of 250 versts. Naphtha wells have also been discovered in many localities on the same side of the Caucasus in the province of Tersk, between the rivers Sunzha and Terek, and in the province of Daghestan. On the south side of the Caucasus, naphtha occurs in the government of Elisavetpol, between the towns of Shousha and Elisavetpol in the government of Tiflis, and lastly in the government of Kutais.

But the south-eastern extremity of the Caucasian range, forming the Apsheron peninsula, is the most remarkable for its abundance of naphtha. Evolutions of gas and naphtha commencing at Shemakhi extend past Baku, across the Holy Island and then continue to the sea in the direction of the Caucasus mountains to the east shore of the Caspian ending in the naphtha and naphthalene deposits of the island of Cheleken. The naphtha springs of the Apsheron peninsula are chiefly concentrated in its central portion about thirteen versts to the south-west of Baku between the villages of Balakhany, Sabunchy, Romany and Zabrat and over the neighbourhood of the villages Binagady and Bibi-Eibat. More or less numerous and productive naphtha springs also lie about the neighbourhood of the villages of Sourakhany and Khourdalan, in the Yasamal valley near the borders of Bakhcha and along the shores of the Caspian to the north and from the Apsheron peninsula to the south. Lastly rich sources of naphtha have been discovered to the east of the Caspian in the Transcaspian province.

The presence of naphtha in Russia has been long known, and as early as 1745 there existed works belonging to a merchant named Nabatov for treating raw naphtha, in the Pechirsk district at the mouth of the river Okhta. However, the production in Russia only attained a really commercial importance at the beginning of the present century. By a treaty signed between Russia and Persia at Hulestan on October 12, 1813, the khanates of Baku, Kouban and Derbent were united to the Empire and from that time Russia became the possessor of the rich naphtha sources of the Apsheron peninsula which, as the Arab writer Massoundi states, had been worked since the ninth century, B. C.

At first, however, the naphtha industry of the Caucasus developed very slowly, and up to 1860 the yearly yield did not exceed 250,000 to 300,000 pouds. The reason of this apparently strange phenomenon was chiefly due to the fact that, after making a few unsuccessful attempts at exploiting the naphtha sources itself, the Government decided upon a farming-out system, without giving sufficient liberty to private enterprise. Another important circumstance was that the preparation of lighting oil from the raw naphtha was unknown before the middle of the present century. Although about 1823, Doubinin Brothers made a successful attempt at Mozdok, to obtain an oil fit for lighting purposes from raw naphtha, still the industry which they had thus started did not attract sufficient attention and was soon given up, so that until 1860, the naphtha was exclusively employed in the raw state either for burning or as a coarse lubricant, thus accounting for its small demand.

The success of the photogene production in Germany gave an impetus to the Caucasian naphtha industry. In 1860 a refinery was started at Sourakhany, and

in 1864 the Baku works were inaugurated, owing to which the demand for naphtha became larger and its production gradually increased. Thus in 1863 the yield of naphtha was 340,000 pouds, in 1867, 999,000 pouds and in 1870, 1,704,000 pouds.

In 1864 also, exploratory borings were first conducted in the Caucasus in the province of Kouban. The first successful well was finished in 1866 in the valley of the river Koudako, which gave the first naphtha fountain in the Caucasus. However the naphtha, although abundant, was heavy and unsuitable for use. Further boring, to a depth of 570 feet, showed the presence of a light naphtha, and the explorations made in the valley of the river Kouban and its tributaries showed that the discovery of naphtha might be expected over nearly all the district. Lastly in 1871, the first well was sunk in the Balokhan district and although its productiveness did not exceed that of the richer springs, still the advantages of borings over the primitive diggings became evident.

The above mentioned circumstances convinced the Government of the necessity of removing the petroleum districts of the Caucasus from the exclusive enjoyment of the farmer to whom they were leased and to render them free to all desirous of exploiting them. The farming-out system was abolished by a law dated February 1, 1872, and according to the general fundaments of the mining legislation, the naphtha industry was pronounced free. By the same law, the refining of naphtha and the manufacture of photogene was subjected to excise. In acting thus, the Government was not misled in its calculations of founding an important economical and commercial industry, conducive to the interests of the State.

The publication of the law of February 1, 1872, was immediately followed by brilliant results; the public auctions of the State naphtha springs in the Caucasus, previously held by the farmers, exceeded all expectations. All the naphtha sources of the Bolokhana district were divided into seventeen lots, about ten dessiatines each, with one or more wells in each. At the auctions, allotments valued at 523,300 roubles, were sold for 2,851,200 roubles.

Notwithstanding the high prices given for the allotments, the buyers quickly set themselves to the exploitation of the naphtha, and instead of digging, sank wells to a greater depth and thus attained striking results. The production of naphtha began to increase rapidly, in a manner which could in no way have been looked for. The exploitation of naphtha was also begun on private lands, and the industry became still more animated owing to the energetic borings made by the proprietors of naphtha-bearing land, among whom a competition soon sprung up. The appearance of the first naphtha fountain in this district in 1873, produced an entire revolution in the industry. The price of naphtha, which in the beginning of 1873 stood at 45 kopecks a poud, immediately fell to two kopecks. This fountain presented an exceedingly tempting phenomenon to many, and although a portion of the naphtha it threw off was lost, it did not retard the search for fresh deposits, but on the contrary strengthened the faith in boring as the best means of attaining quick wealth. The rapidity of the growth of the production of naphtha in Russia, during the first years after the publication of the freedom of the industry, is seen from the fact that up to 1872 the entire production of the Empire did not exceed 1,750,000 pouds, while in 1873 the Bolakhana and Sabouncha districts alone yielded 3,951,600 pouds, 4,862,600 pouds in 1874, and 5,809,000 pouds in 1875. The publication of the freedom of the naphtha industry not only facilitated the rapid increase of the production of raw naphtha, but under favourable conditions also conduced to the development of the manufacture of photogene, and many works were built for the distillation of the product.

The appearance of a series of abundant naphtha fountains, put an end to the hope of a rise in price owing to increased demand. The Baku market had always a surplus over the demands of the local refining works, and as early as 1875, when the yield did not yet exceed six million pouds, there was a crisis in the Baku naphtha industry followed by the stoppage of many of the refining works. In 1877 the Government with a view to develop the industry, decided to abolish the excise upon photogene.

From this time the Baku naphtha industry made rapid strides forward, and in 1888 had attained such dimensions that the Government saw the opportunity of placing a moderate excise upon naphtha lighting oil. In 1887 the yield of naphtha was 167,000,000 pouds and 46,000,000 pouds of lighting oil had been prepared. This excise, to the amount of forty kopecks per poud upon ordinary light kerosene, and thirty kopecks upon the less dangerous heavy lighting oil, did not evince any unfavourable influence upon the now firmly established industry, and in 1890 the yield of lighting oil amounted to seventy million pouds; that is, it increased fifty per cent over the production of 1887. In 1890 the revenue brought to the Government by the excise upon naphtha oil exceeded ten and a half million roubles.

Notwithstanding the favourable results attained by the publication of the freedom of the naphtha industry, a twenty years application of the regulations published in 1872 showed the existence in them of many imperfections and wants whose completion was desirable both in the interests of the naphtha industry and of the State. Therefore, these regulations were revised and replaced by new ones on the 3rd of June, 1892. Based as before upon the freedom of the industry, the new regulations gave greater advantages to the discoverers of naphtha sources, facilitated the conditions of leasehold of State naphtha bearing lands, removed impediments to the laying down of pipe lines over State and private properties, established measures for preserving the industry from the dangers of fire, took measures against the rapacious and irregular exploitation of the naphtha sources, and gave a definite organization to the periodical meetings of the naphtha traders for discussing the general needs of the industry.

The following table shows the growth of the yield and of the refining of naphtha during the last ten years.

Years.	Naphtha.	Lighting oil.	Benzine.	Lubricating oil.
	Pouds.			
1881	40,474,731 *	12,840,656	2,922,815	
1882	50,507,723	16,427,776	—	1,781,494
1883	60,375,970	15,145,401	49,544	3,044,220
1884	90,229,812	20,340,544	151,000	3,406,346
1885	116,258,915	34,148,176	41,072	2,963,838
1886	120,410,927	37,837,306	61,280	2,526,500
1887	166,868,759	46,108,648	242,263	4,008,453
1888	194,341,955	52,120,653	144,157	3,713,452
1889	202,127,942	64,992,245	111,095	3,157,418
1890	242,941,629	69,973,884	124,892	5,374,000

* In the case of naphtha of sp. gr. 0·87, one poud corresponds to 4·94 American gallons.

Thus during the last ten years the production of naphtha increased six times and the preparation of lighting oils, nearly as much.

The accompanying table shows the yield of naphtha in the different governments and provinces during the last two years.

Governments and Provinces.	Yield of naphtha, in pouds.	
	1889.	1890.
Gov. of Baku	200,116,300	240,380,924
Prov. of Kouban	1,881,942	1,813,327
Transcaspian Prov	286,400	285,000
Prov. of Tersk	275,721	370,800
Gov. of Tiflis	55,296	46,444
Prov. of Daghestan	3,955	2,780
Gov. of Tauride	3,603	29,168
Gov. of Elisabetpol	3,000	11,000
Prov. of Fergan	1,425	2,106
	202,127,942	242,941,629

The above figures show that the first place in the Russian naphtha industry is occupied by the government of Baku, or strictly speaking, by the Apsheron peninsula, where 99 per cent of the total yield is produced. Hence an examination of the data respecting this district will be of the greatest interest and importance.

The Apsheron peninsula presents an uneven and, in general, but little elevated surface; in places it is intersected by shallow but rather wide and sometimes contracted valleys. It is chiefly covered with sand, and only partially by salt marshes, salt lakes and mud volcanoes. In its geological structure the peninsula is exclusively formed of post-tertiary and tertiary formations the oldest of which are marles and schists of the upper eocene period. The stratification of all these formations are broken, the dislocations appearing in two predominating directions north-west and north-east. In the majority of cases the natural outflow of naphtha appears on the sides or crests of anticlinal curves or in narrow and deep anticlinal valleys of rupture. The naphtha lies in oligocene formations and is chiefly concentrated in sands and friable sandstones. The total thickness of the naphtha bearing tier of oligocene is not less than eight hundred and fifty to a thousand sagenes; and the thickness of the actual naphtha bearing sands and sandstones extends to 150 sagenes.

The quality of the naphtha varies considerably, and starting from an immobile black viscous mass of specific gravity 0·96 it passes through all the transitions to a mobile, light yellow liquid of specific gravity 0·85 to 0·885, having a peculiar odour, dichroism and fluorescence. In its chemical composition the Baku naphtha presents a mixture of hydrocarbons, in which the unsaturated hydrocarbons of the series C_nH_{2n} predominate. These hydrocarbons are known as the olefines and resemble the hydro-aromatic hydrocarbons in their properties.

The Balakhana-Sabouncha naphtha, on being destilled in the usual manner, that is, without crocking, gives:

Light oil (benzene, gazolène)	5— 7 per cent.
Kerosene	27—30 » »
Solar oil (heavy lighting oil)	13—15 » »
Lubricating oils: spindle oil	7 » »
» » machine oil	18—25 » »
» » cylinder oil	2— 5 » »
Vaseline	1 » »

In the preparation of kerosene only, the majority of works obtain:

Kerosene	35 per cent.
Refuse	55 » »
Light oils and waste	10 » »

The heating power of the naphtha, on the average, equals 11,370 calories. The amount of ash does not exceed 0·09 per cent.

The naphtha is exploited by borings, generally made by means of rigid rods with free falling tools; the rope system of boring is rarely employed owing to the local conditions being unfavourable to it.

In 1890 there were 105 allotments under exploitation in the government of Baku. The total number of wells was 376, each well, therefore, yielding on the average 644,452 pouds of naphtha. It is remarked that, in general, the average productiveness of the wells has fallen somewhat. The depth of the newly sunk holes has at the same time increased. In 1881 the average depth of the new wells did not exceed sixty sagenes, but in 1890 it already attained 107 sagenes. A considerable amount of naphtha is thrown up in the form of fountains and during the last few years they yielded as follows:

Years.	Yield of fountains.	Percentage of total production.
1887	68 million pouds	42 per cent.
1888	73 » »	40 » »
1889	42 » »	22 » »
1890	49 » »	22 » »
1891	39 » »	10 » »

The naphtha is stored in various ways, the most usual method is in earthern and stone warehouses having a capacity of as much as eleven million pouds, or in iron reservoirs holding as high as five million pouds. The stores of naphtha are not as a rule large, and rarely exceed nine to ten million pouds. The oil is supplied to the Baku works by means of twenty-five pipe lines having a total length of 260 versts and capable of supplying up to one and a half million pouds daily. In 1890 there were 224 refining works, 148 of which were situated in the neighbourhood of Baku and the remainder in various parts of European Russia. Of the Baku works, 135 were small, and 13 were constructed on a larger scale; the latter gave three-fourths of the total production of naphtha products in Baku.

The largest works belong to the Nobel Brothers; in 1890 these works produced 17,964,400 pouds of various petroleum products. In 1890 the naphtha industry of Russia employed 10,503 men, of which number 4,509 belonged to the refining works.

Lighting and lubricating oils and other naphtha products are chiefly transported from Baku to the interior of Russia in tanks, by the Caspian Sea to Astrakhan, thence also in bulk up the Volga, and then by rail in cistern trucks over the whole of Russia. Another portion is carried by rail from Baku to Batoum, whence it is transported in tanks to the various ports of the Black Sea and Sea of Azov for home consumption, or else in all directions abroad. Before being transported all the lighting oils are tested on the spot of their preparation by Government agents and, according to the law of March 8, 1886, oil with a flash point of under 28° Celsius (Abel-Pensky's apparatus) is pronounced dangerous and only admitted for sale under certain limiting conditions. In 1890 the official data show that 29,963,260 pouds of lighting oil, or about 43 per cent of the annual production, went to home consumption. Taking the population of Russia in 1890 at 117 millions, the consumption per head comes to 10·2 pounds.

Besides being a cheap mode of illumination, mineral oil now plays an important role as a fuel. It is only natural that the boilers used in the production of naphtha should be heated by no other fuel, the naphtha thus consumed amounting to 11,781,000 pouds. The large quantity of refuse obtained at Baku is partially consumed on the spot, and a comparatively small quantity is sent abroad, but the chief amount is transported to the interior where it is used as fuel. At the present time not only the steamers navigating the Caspian, but also the majority of those upon the Volga and its chief tributaries, employ naphtha fuel, and the amount of naphtha refuse thus consumed equals about fifty-eight million pouds.

There are very accurate data respecting the consumption of naphtha refuse for locomotives, and the quantity thus employed steadily increases every year, clearly showing the advantages offered by this class of fuels. The following are the data published by the Ministry of Ways of Communication respecting the consumption of naphtha fuels on the railways:

1881	115,600 pouds	1886	5,788,500 pouds
1882	131,900 »	1887	6,741,000 »
1883	1,720,400 »	1888	8,707,600 »
1884	3,887,200 »	1889	12,994,100 »
1885	5,042,700 »	1890	17,654,600 »

Independent of this, naphtha refuse has in recent years been applied to all kinds of industrial works, not only locally along the Volga but also in the central governments of Russia. Here naphtha fuel is used not only for heating boilers, but also in metallurgical furnaces in the manufacture of iron. In the Caucasus also, naphtha refuse is employed in copper smelting. According to the data of the Ministry of Finance, the consumption of naphtha fuel by all classes of industries in Russia amounts to eighteen million pouds a year. In 1889, Baku shipped 88,886,400 pouds of naphtha refuse and in 1890, 96,905,900 pouds. A very small portion of this amount was transported to Batoum and all the remainder was consumed in the interior of Russia chiefly as fuel, only a small quantity being converted into other products.

As regards the external trade in naphtha products, in 1873 the importations of volatile lighting oils into Russia amounted to about three million pouds, but since then and especially since 1882 it has steadily fallen, and during the last four years has reached a minimum, as the following table for the last ten years shows.

Years.	Lighting oil.	Raw naphtha.	Years.	Lighting oil.	Raw naphtha.
	Pouds.			Pouds.	
1881	1,298,500	27,250	1886	40,700	59
1882	1,032,300	15,550	1887	15,000	37
1883	389,300	19,200	1888	11,400	110
1884	181,600	14,100	1889	16,200	111
1885	118,100	1,550	1890	15,100	12

The almost total cessation of the importation of American lighting oil into Russia is explained by the rapid growth of the output of all kinds of naphtha products, and chiefly of lighting oil, and also by the excess of their production over the requirements of the interior of Russia.

At the same time the exportation of naphtha products has rapidly increased as the following table indicates.

Years.	Raw naphtha.	Lighting oil.	Lubricating oil.		Naphtha refuse.
			Refined.	Unrefined.	
	Pouds.				
1881	182,600	134,500	309,100	276,800	67,000
1882	112,000	228,700	327,100	376,200	77,500
1883	283,700	1,493,700	454,300	1,266,700	60,400
1884	602,800	3,948,900	604,800	853,000	451,700
1885	1,129,300	7,269,500	648,200	1,490,400	208,200
1886	1,257,800	9,195,300	776,300	1,452,200	2,255,600
1887	1,078,100	11,819,500	1,136,600	1,664,400	3,281,700
1888	299,400	27,363,300	1,515,700	1,281,600	4,481,300
1889	224,700	34,989,400	1,527,800	1,926,800	6,129,500
1890	760,700	39,767,200	3,433,500	1,133,700	2,986,400

The figures of this table clearly indicate the importance of the naphtha industry of Russia. Indeed, while in 1873 when the largest amount of naphtha products were imported, Russia paid over ten and a half million roubles for lighting oil and raw naphtha of foreign production, and in 1890, on the contrary, she exported various naphtha products of home production, to the value of over twenty-seven and a half million roubles. Of all the naphtha products the Russian lighting oil has the widest market.

In 1881 the export of this oil amounted to 134,500 pouds, and after a space of ten years, in 1890, it increased to 39,767,200 pouds; the relation between the total production of lighting oil and the amount exported in 1890 is about 57 per cent. The exportation of lubricating oils, which in 1881 amounted to only 585,900 pouds, rose to 4,567,200 pouds in 1890. With respect to lubricating oils it must be remarked that at first more unrefined than refined oil was exported, but recently there is observed an evident preference for Russian refined oil, which in 1890 amounted to three-quarters of the total of lubricating oils exported. It is interesting to observe which are the chief foreign markets for the Russian naphtha industry, and this is shown in the following table giving the data for the last three years.

Countries.	Lighting oil and benzene.			Lubricating oils. Refined.			Lubricating oils. Unrefined.			Naphtha refuse.		
	1888.	1889.	1890.	1888.	1889.	1890.	1888.	1889.	1890.	1888.	1889.	1890.
	Pounds.											
Great Britain	6,019,926	6,865,848	7,822,022	233,651	76,480	586,465	193,081	231,951	156,357	393,381	474,981	557,599
Austria	3,941,747	4,009,675	5,831,271	85,230	72,661	149,950	239,310	87,010	26,512	3,199,124	4,464,588	888,411
Germany	2,775,549	2,783,058	1,876,120	269,797	271,200	750,053	309,003	553,284	298,423	302,907	421,758	198,879
France	169,593	45,480	151,120	433,794	498,955	672,814	217,547	490,220	263,918	193,250	236,657	469,647
Italy	449,142	2,042,260	2,601,376	42,652	26,444	79,941	12,365	33,512	7,320	39,702	28,645	42,770
Belgium	1,508,447	1,841,428	1,088,704	214,308	277,059	871,659	58,165	123,966	83,795	230,749	346,988	606,515
Holland	471,257	537,842	432,590	33,718	135,433	41,425	176,647	210,830	163,662	30,500	—	22,575
Roumania	279,406	526,784	—	10,594	28,078	6,414	44,725	93,440	35,271	—	—	—
Spain	—	519,450	—	10,130	—	68,790	—	—	12,920	—	—	48,000
Denmark	481,527	467,836	354,235	33,718	21,543	18,191	10,133	55,233	49,341	19,703	8,453	26,147
Sweden and Norway	640,847	413,416	387,674	8,828	5,866	10,034	14,386	16,067	17,474	—	—	—
Greece	12,935	46,174	21,400	—	—	—	—	—	—	—	—	—
Turkey	5,267,431	7,482,907	7,662,780	3,308	—	25,217	—	26,268	—	—	—	—
Persia	291,322	365,525	341,675	—	—	—	—	—	—	56,248	134,706	107,043
India	—	5,201,286	9,913,498	—	—	—	—	—	—	—	—	—
China	—	1,020,290	—	—	—	—	—	—	—	—	—	—
Japan	—	329,750	—	—	—	—	—	—	—	—	—	—

This table shows that the products of the Russian naphtha industry not only find a market in Europe but also in the far east. The chief consumers are those countries to which the naphtha can by carried by the cheap sea route from Batoum, which is connected by rail with Baku, the centre of the industry.

ASPHALT.

Asphalt bearing sandstone and limestone occur on the right bank of the Volga in the Syzransk district of the government of Simbirsk, where there are four works for treating the raw material and for preparing bitumen and asphalt compositions, of which they turn out from 750,000 to 1,000,000 pouds per year.

Moreover, the same products are extracted in various parts of the Caucasus, to the amount of over 100,000 pouds annually.

SULPHUR.

Deposits of sulphur exist in many parts of Russia, but they have nowhere been fully explored. Thus sulphur occurs on the shores of the Volga, in Poland, the Caucasus, and in the Transcaspian and Fergan provinces. In the government of Kazan, it is known to occur near the village of Sukeevo on the Volga. The ore here lies in druses and interlayers in limestone of the Permian system, whose thickness varies between two and seven feet. The percentage of sulphur in the ore varies between 2·5 and 8 per cent. There formerly existed works for treating the ore, but they are now closed.

In Poland there is a deposit of native sulphur, in the government of Kelets, near the junction of the rivers Nida and Vistula, at the village of Charkovo. The sulphur is here disseminated in a marl of the tertiary system whose thickness varies from one to ten sagenes. The distribution of the sulphur in the gauge is extremely variable, the upper layers generally contain not more than ten per cent, while in the lower it varies from 25 to 75 per cent. Explorations made on the Kharkova mines showed the presence of very considerable stores of sulphur. Works were erected upon the deposit and in 1885 yielded as high as 35,000 pouds. Now these works are closed. Besides the Charkova deposit the geological survey of the same portion of the government of Kelets showed the existence of a fresh bed of sulphur. In the Caucasus native sulphur is found pretty widely distributed over both sides of the mountain chain.

In the province of Daghestan, there is a bed of sulphur belonging to the upper jurassic system, situated about 120 versts to the west of Petrovsk, on the Caspian Sea near the village of Chirkat, in the mountains at a height of 4,500 feet above the level of the sea. The ore here occurs in considerable agglomerations in clay; it contains from 33 to 35 per cent of sulphur. The deposit has been only regularly exploited since 1883, when a French firm, Lescanne Perdoux fils et C°. took over the Chirkat or Khioutsk mine. In 1888 this firm produced 88,000 pouds of sulphur but lately the output has considerably fallen.

Besides the Chirkat deposit, native sulphur is found in other parts of Daghestan and also in the governments of Erivan and Tiflis. A vast bed of sulphur has recently

been discovered and explored in the Transcaspian province about 240 versts from Geok-Tepé and Khiva. In this locality there are solitary, standing hills about 300 feet high, rising in the midst of the uniform sandy steppes. These hills contain nests and veins of quartzose sandstone containing over 60 per cent of sulphur. There are forty such hills, and it has been estimated that each hill could yield as much as thirty million pouds of sulphur, and the local conditions are very favourable to the establishment of sulphur works on a large scale. A deposit of sulphur is also known in the Fergan province where there are works for treating the ore. The following table gives the yield of sulphur during the last ten years.

Years.	Yield of sulphur.	Years.	Yield of sulphur.
	Pouds.		Pouds.
1881	6,500	1886	72,000
1882	39,700	1887	88,300
1883	70,900	1888	22,700
1884	46,100	1889	5,800
1885	108,700	1890	9,800

With such a small home production of sulphur, Russia is obliged to cover its requirements by importation which, during the last five years, is expressed by the following figures.

Years.	Imported.	
	Raw sulphur.	Refined sulphur and flowers of sulphur.
	Pouds.	
1886	484,700	34,300
1887	899,600	64,900
1888	1,363,400	34,700
1889	1,165,900	28,800
1890	1,125,000	28,400

Raw sulphur is imported from Italy. In 1890, 75,300 pouds were for the first time brought from the United States. Refined sulphur chiefly comes from France.

According to the customs tariff of 1891, sulphur imported into Russia is subject to the following duties:

1. Raw sulphur:

   a. Imported to the ports of the Baltic and White Sea, and also by land . . . . 2 kopecks per poud.

   b. Imported to the ports of the Black Sea and Sea of Azov . 5 » » »

2. Refined sulphur and flowers of sulphur . . . . 20 » » »

GRAPHITE.

Graphite was first discovered in Russia in 1826. Deposits of graphite are known in various parts of Russia in Europe and Asia; but it has as yet only been exploited in the Kirghiz steppes, in eastern Siberia and in Finland. The deposits of eastern Siberia are especially worthy of attention. In 1856 a Finnish merchant, named Aliber, began to work graphite in the government of Irkutsk, where there is a bed of the highest quality. At one time this graphite was supplied to the well known pencil makers Faber, but at present it is only worked in the smallest quantities to satisfy the wants of the Irkutsk gold melting house, for the manufacture of crucibles. Very vast deposits of graphite of most excellent quality were discovered in 1860 by a merchant named Sidorov, in the north of the government of Yenissei, along the rivers Nizhni-Toungouska and Koureika. The former deposit is estimated to contain ten million pouds of graphite. The high qualities of this ore were certified at the Perm gun factory, and in St. Petersburg, and also in London whither a parcel of it was sent by sea across the Arctic ocean. The situation of these deposits in a distant desert and unpopulated district is the cause of their not being worked.

In general the production of graphite in Russia is subject to considerable fluctuations, and sometimes it is not extracted in the least degree for several years running. Judging from official data the largest amount of graphite was yielded in 1875 when the production amounted to 18,500 pouds. According to the customs tariff of 1891, graphite imported into Russia is subject to duty as follows:

1. Graphite in lumps.	8 kopecks per poud.
2. Graphite powder	30 » » »

PHOSPHORITES.

Phosphorites are known in many parts of Russia, but they are only exploited in the governments of Podolsk, Bessarabia, Kursk and Kostroma. In Bessarabia and Podolia the working area is situated along the shores of the river Dneister and its tributaries. The phosphorites lie in schists of the silurian system and have the appearance of more or less regular spheres from one-half to seven inches in diameter.

Numerous analyses conducted in Austria have shown that these phosphorites are far richer than those of other localities, containing, as they do, 70 to 75 per cent of phosphate of lime, which corresponds to 30 or 35 per cent of phosphoric acid beds. In respect to their size the most important phosphorite beds in Russia are those which occur in the midst of strata belonging to the cretaceous system, where the phosphorite, locally called nugget, is composed of sand cemented together by phosphate and carbonate of lime. In the interior of Russia these beds extend to the northern limit of the cretaceous formations. The richest deposits are situated in the governments of Smolensk, Kursk, Orel and Voronezh; the length of this band is over 600 versts and its width about 150 versts. The percentage of phosphoric acid in the nugget varies from 13 to 27 per cent. In the government of Kostroma the ore contains from 22 to 26 per cent of phosphoric acid.

There are no data giving the total production of phosphorites in Russia and it can only be said that their use is extending more and more in the Empire. But Russian phosphorites also form an object of export as the following data from the official customs statistics show.

Export of phosphorites.	1886.	1887.	1888.	1889.	1890.
	P o u d s.				
Total	674,900	468,700	448,500	521,100	705,400
Including, to Germany.	10,000	—	—	—	—
» » Austria. .	663,500	468,700	448,500	521,100	705,400

According to the customs tariff of 1891, the exportation of phosphorites in the raw state is restricted by a duty of 12 kopecks per poud; while ground phosphorites are passed free of export dues. On the other hand ground phosphorites imported into Russia are subject to a duty of 2 kopecks per poud in gold.

Precious stones and building materials.

Among the precious stones, diamonds, rubies, sapphires, emeralds, topazes, amethysts, aquamarines, beryls, garnets and alexandrites are found in Russia. Diamonds were first discovered in 1829 in the Krestovozdvigensk gold workings in the central Urals. Subsequently they were also found in working the gold of other mines, but in general, they are of rare occurrence. There are no real diamond mines, and only a portion of the Krestovozdvigensk was temporarily worked exclusively for diamonds. Altogether about 160 diamonds were found, the largest of which weighed about $2^{15}/_{16}$ carats. As yet no diamond bearing rocks are known in the Urals.

Sapphires and rubies are also rarely found in alluvial gold deposits, together with other more or less rare minerals, such as euclase, rose topaz, chrysoberyl, chrysolite, zircon, rutile et cetera. But in the Urals, emeralds occur in quite a different manner. Their deposits form an entire group situated to the north-east of Ekaterinburg. Here exceptionally large crystals of emeralds, chrysoberyl and phenacite are met with in a micaceous schist.

Very fine topazes, beryls and phenacites are found in the southern portion of the Urals, in the Ilmen hills. These stones are also found in the Mourzinsk deposits, situa ted about a hundred versts to the north-east of Ekaterinburg. The Mourzinsk topazes and beryls are known to the mineralogists of the whole world. The largest topaz known was found here; it is now in the Museum of the Mining Institute, and measures 27 centimetres in length, and 31 centimetres in circumference. Topazes, aquamarines and beryls are also found in the Nerchinsk mountains in eastern Siberia. A crystal of topaz of exceedingly large dimensions was found in one of the gold workings of this locality. In general, garnets are of frequent occurrence in the Urals. Here different varieties of greenish coloured garnets are known. If these stones contain a small amount of chromium they have an emerald green tint, and a very powerful lustre, and indeed exceed the emerald in beauty.

Rock crystals and amethysts are found in many parts of the Urals and Siberian mountains. The Urals long ago attracted attention by their richness in precious and coloured stones, and in 1755 a Government Stone Cutting and Polishing Works was established at Ekaterinburg. At the present time the cutting of the precious stones and the polishing of the various rocks and minerals found in the Urals, is chiefly carried on by the former workmen of the above establishment, which has almost ceased working; the industry has now developed into a rather large peasant occupation (koustarny promyshlènnost).

Amber is found in the governments of Courland, Grodna, Kiev, Volynsk, Minsk and Kherson. Moreover, it is cast up by the Baltic Sea in the neighbourbood of Libau and also on the shores of the Arctic ocean at the mouths of the rivers Pechora and Mezen. Those practically useful minerals, which are found as mountain rocks or in the form of more or less considerable masses will now be noticed.

Lapis lazuli is known in several localities about Lake Baikal in eastern Siberia. Malachite is met with in the Urals, frequently accompanied by other copper ores, sometimes in huge blocks. In the Museum of the Mining Institute there is such a block weighing about 90 pouds, which formed part of a still larger block weighing 170 pouds.

Labradorite occurs in the governments of Kiev and Volyn, in considerable masses, subordinate to granite. This stone is used in building, for facing walls and for making ornaments.

Granite occurs in abundance both in the south and in the north of Russia, but it is only regularly quarried in a few places. St. Petersburg is supplied with two sorts: the red or Viborg granite, locally called rappakivi, is quarried in Finland on the shore of the gulf of Finland between Viborg and Borgo; and the gray, so called Serdobolsk granite, is chiefly transported from the neighbourhood of the town of Serdobol on the north shore of lake Ladoga.

The red, large grained Finnish granite or rappakivi is used in large quantities in St. Petersburg; all the quays of the Neva and the canals are walled with it, and the foundations of many buildings as well as all the port and fortifications of Cronstadt are built of it. The most remarkable monolites of rappakivi are those out of which the columns of the St. Isaac Cathedral and the monument of the Emperor Alexander I are made; the latter is 78 feet high and 12 feet in diameter. Besides the granite cut from quarries, there is a large demand for granite cobbles which are found largely disseminated over a great portion of the north and interior of Russia. In the north, huge blocks of granite are sometimes met with, like that which forms the base of Peter the Great's monument in St. Petersburg. The Serdobolsk granite is dark gray, fine-grained, exceedingly hard, and polishes with difficulty. It is used for architectural ornamentation; for example, the huge figures, supporting the portico of the Imperial Hermitage of St. Petersburg are made of it. In the south of Russia, granite is very widely distributed over the governments of Ekaterinoslav, Poltava, Podolsk, Volyn, Bessarabia and Tauride. There are large granite quarries in the governments of Volyn and Podolsk. In the government of Voronezh, there are granite quarries on the banks of the river Don.

Jasper occurs in the Ural and Altai mountains. The largest amount is found on the eastern side of the south Urals. The Kalkansk jasper is the most beautiful. In the Altai a very large number of beds of different kinds of jasper are known and worked up by the local Kolyvansk polishing works into such large objects as the vases, and oval bowl 20 feet across, which are preserved in the Imperial Hermitage.

Marble is found in many parts of Russia, but it is far from being worked in all the localities of its occurrence. There are marble quarries in Finland, in the government of Olonets, in the Urals and in Poland. A white marble is found on the eastern side of the Urals near Ekaterinburg; it is cleavable into pieces up to seven feet long; in the purity of its colour it excels some kinds of Carrara marble. In the government of Olonets there are the Tivdisk marble quarries, which were opened out in the reign of Catherine II, and which have been worked on a very large scale for many monumental works in St. Petersburg, the St. Isaac Cathedral being among them. In Finland there are the Ruskiolsk marble quarries. In Poland, marbles of the most varied colours and designs occur in the neighbourhood of the towns of Kelets, and Hentsina. These marbles have been quarried since the sixteenth century. A black marble is known in the neighbourhood of the town of Olekoush, about twelve versts distant from the Austrian frontier. This marble has also been quarried since the seventeenth century. The ikonostas in the Cathedral of St. Stephan in Vienna is made of it.

Limestones are also quarried in many parts of Russia, as for instance, in the neighbourhood of Moscow, where the Miachkov quarries are the best known. This limestone is distinguished for its whiteness, homeogenuity and purity; it is sufficiently soft to admit of being chiselled, and is therefore used for making ornaments. Calcareous limestone of the tertiary system is largely distributed in the south of Russia, and some towns, as for instance Odessa, are almost entirely built of it; when damp it is very soft and easily disintegrates, but hardens when dried. Marles are used in the preparation of hydraulic cements and occur abundantly in the governments of St. Petersburg and Esthonia. Those found near the town of Novorossisk are remarkable for their high quality, and are used for making Portland cement.

Quartz and quartzose sandstone are also known in various parts of Russia. The government of Olonets is especially rich in them. The dark red Shokshink quartzose sandstone of this locality is used for many monuments, and the tomb of Napoleon I, in the Paris Hôtel des Invalides, is made of this material, the gift of the Emperor Nicholas I. In the neighbourhood of Moscow there are several sandstone quarries which give an excellent building material and grindstone. Such sandstone also occurs in the Urals, in the governments of Kursk, Kharkov, Saratov, in Poland, and other places.

Whetstone is exploited in the governments of Vologda, Ufa and Ekaterinburg. Lithographic stone is found in the governments of Perm and Podolsk. Slate is known in the north of Russia in the government of Olonets, in the south of Russia near the Krivoy-Rog, on the borders of the governments of Cherson, and Ekaterinburg, and also in the Caucasus.

Asbestos and talc occur in various parts of European Russia and Siberia. In the Urals, asbestos is now chiefly extracted in the neighbourhood of Ekaterinburg, and in 1891, 72,000 pouds were taken from that locality.

Gypsum beds are known wherever the Permian system occurs in the east of Russia in Europe; it also lies in the same formation in the government of Ekaterinoslav. Gypsum is known in the Devonian system, in the governments of Pskov, Vitebsk, and Lithuania; it lies in more recent formations in the governments of Poltava and Podolsk and also in Poland.

Chalk is worked in considerable quantities in the government of Simbirsk and Kharkov and in other localities. Among the numerous varieties of clay known in all

the governments of Russia and lying in all kinds of geological formations, the most important, from an industrial point of view, are the china and fire clays.

Kaolin is known in many parts of south Russia where it forms the product of the desintegration of granite and gneiss. Large deposits of kaolin are known in the governments of Ekaterinoslav, Kherson, Kiev, Volyn and Chernigov. In the interior of Russia the Gzhelsk beds of china clay, about 50 versts from Moscow, have been worked for a very long time. Fire clay is also worked in many parts of Russia. The most important are the fire clays of the carboniferous system, which are worked on a large scale in the governments of Novgorod, Tver and Tula. Besides this, fire clay is worked in the governments of Vladimir and Olonets, in the Donets coal basin, and in the western portion of the government of Ekaterinoslav and also in Poland.

According to the official data for 1890, which only include the stone quarries subject to the supervision of the Mining Department, the following number of men were employed in these industries:

In the exploïtation of kaolin.	760 men.
» » » » fire clays	1,318 »
» stone quarries	16,443 »
Total. . .	18,521 men.

Mineral springs.

By the law of February 19, 1885, for the preservation of mineral springs, the land surrounding the springs is, within a certain area, subject to preservative measures, and the landowner cannot conduct any kind of work upon it without the previous permission of the mining authorities.

Among the numerous mineral springs of Russia the following are included under that law.

In northern Russia: the Starorussk, in the government of Novgorod; the Hillovsk, in the government of Pskov; and the Kashinsk, in the government of Tver; in central Russia: the Lipetsk in the government of Tambov; in western Russia: the Kemmernsky in Lithuania, the Baldonsk in Courland, and the Druskeniksk in the government of Grodno; in Poland: the Tsekhotsinsk, in the government of Warsaw, and the Bussk, in the government of Kelets; in Eastern Russia: the Serghievsk and Stolypin, in the government of Samara; in South Russia: the Slaviansk, in the government of Kharkov, and the Sakskand Chokraksk mud springs in the Tauride government. In the Caucasus there are four groups of the so-called Caucasian mineral waters: the Podkoumsk, in the province of Tersk, the Borzhomsk in the province of Stavropol, and the Abas-Toumansk in the government of Tiflis.

The most important of all these springs are four groups of the Cau casian waters situated near tho town of Piatigorsk.

At Kislovodsk there is one carbonate spring situated at a height of 2,500 feet above the level of the sea, and known as the Narzan spring, whose temperature is about 15° C. The Essentouksk mineral springs lie at a height of 1850 feet above the level of the sea. These springs fall into two groups, one alkaline and the other sulphurous. The spring No. 17 is especially famous for its strength. The Piatigorsk sulphurous

springs are situated in the town of Piatigorsk and its neighbourhood. Here, as at Essentouki, there is a whole series of sulphur springs varying from 29° to 59° Celsius in temperature. The Zhelesnovodsk springs are ferruginous-alkaline, partly hot (50°) and partly cold; there are in all twelve springs here.

All these four groups of the Caucasian springs belong to the State, and in recent years the Government has expended 800,000 roubles in developing them.

Among the remaining above mentioned springs, the Starorussk, Druskeniksk, Tsekhotsinsk, Bussk and Slaviansk are saline; the Hillovsk, Kemmernsk, Baldonsk and Serghievsk are sulphurous; the Borzhomsk, alkaline; the Kashinsk and Lipetsk, ferruginous, and the Stolypinsk, saline-ferruginous.

Without citing all the remaining springs known in European Russia and the Caucasus, it should be mentioned that numerous chalybeate springs are known in Turkestan, in the Altai in Western Siberia, and in the Transbaikal province of Eastern Siberia. The Transbaikal mineral springs are particularly famous. The medicative lake Shiro, in the southern portion of the government of Yenisei, is of great repute; according to the investigations made by the Faculty, the water of this lake contains a larger amount of alkalis and sulphate of sodium than the frequented waters of Carlsbad, Marienbad and Vichy.

ERRATA.

Page.	Line.	Printed.	Read.
1	28	Nikitin	Nikita.
2	46	Derzabin	Deryabin.
3	16	Vernien.	Verneuil.
3	20	Monpere	Montpéreux.
12	39	Alekminsk	Olekminsk.
17	12	him.	them.
24	23	Bogoslov	Bogoslovsk.
30	24	Baikal	Transbaikal.
42	33	Don	Donets.
50	16	importation	exportation.
55	21	Don	Donets.
56	6	»	»
56	19	»	»
57	5	»	»
61	27	Zisichansk.	Lisichansk.
63	32	1862	1869.
68	19	Russian Siberia	Prussian Silesia
72	29	and carboniferous	carboniferous and jurassic.
73	16	Zaibaikal	Transbaikal.
75	19	Briansk.	Briantsevsk.
82	4	isthmus	peninsula.
82	18	south-west.	north-east.
82	22 and 23	from the Aspheron peninsula to the south	to the south of the Apsheron peninsula.
93	32	topaz	beryl.
95	36	Ekaterinburg	Ekaterinoslav.
96	35 and 36	the Podkoumsk, in the province of Tersk, the Borzhomsk in the province of Stavropol and the Abas-Toumansk in the government of Tiflis	in the province of Tersk; the Podkoumsk, in the government of Stavropol; the Borzhomsk and the Abas-Toumansk, in the government of Tiflis.

THE

INDUSTRIES OF RUSSIA

SIBERIA

AND

THE GREAT SIBERIAN RAILWAY

WITH A GENERAL MAP

BY THE

Department of Trade and Manufactures Ministry of Finance

FOR THE

WORLD'S COLUMBIAN EXPOSITION

AT

CHICAGO

EDITOR OF THE ENGLISH TRANSLATION

JOHN MARTIN CRAWFORD

U S CONSUL GENERAL TO RUSSIA.

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PREFACE.

The beginning of the construction of the Great Siberian Railway, which will unite the most distant points of Europe and Asia and will draw the Old World nearer to the New, practically coincides with the celebration of the 400th anniversary of the discovery of America.

The accomplishment of this magnificent and historic task has fallen to the lot of Russia. Notwithstanding the enormity of the material expenses, Russia has cheerfully and earnestly accepted the undertaking, one of the most important in the history of peaceful acquisition, of knowledge and of labour.

The Great Siberian Railway will benefit not only Russia, it will do great service to the material and spiritual cultivation of humanity, and from this point of view will acquire much importance and interest for the whole civilized world. Following this idea, Mr. S. J. Vitte, Minister of Finance, commissioned the Department of Trade and Manufactures, to prepare for the World's Columbian Exposition at Chicago a description of this great railroad, and also of Siberia, a land little known to the people outside of the Empire.

The present volume therefore contains a history of the occupation and colonization of this extensive territory, its geographical description, the review of its industry and trade, the description of its land and water communications, and finally the history and contemporary state of the questions concerning the construction of the Great Siberian

Railway. In order to explain more clearly the geography of the land, this work is furnished with a map of the Russian Empire showing the general network of Russian railways, together with the Great Siberian Railway as well as the principal deposits of the noble metals, with which the country is richly provided.

The present edition has been accomplished under the direction of Mr. V. I. Kovalevsky, Director of the Department of Trade and Manufactures, and President of the Imperial Russian Commission for the World's Columbian Exposition at Chicago, together with the active assistance of Senator P. P. Semenov, Vice-President of the Imperial Russian Geographical Society, a man well known to the civilized world through his geographical works. This volume is being simultaneously translated into the English language with the kind assistance of the Consul-General of the United States, Mr. J. M. Crawford, who consented at the request of the Imperial Ministry of Finance to supervise and edit the English translation of this work.

PREFACE

TO THE

ENGLISH TRANSLATION.

Of that great expanse of territory reaching all the way from the Ural mountains to the Pacific Ocean and from the Frozen seas to the borders of the Celestial Empire there is perhaps little more than the name, Siberia, authentically known to the general public. Yet with its wide-stretching plains, its magnificent water systems and its unknown wealth of noble metals and other valuable mineral deposits buried in its bosom, there is for such a land a future too great to be overlooked at the present day.

With the steel rails of the Great Siberian Railway piercing their steady way through the vast country to the Far East, thus completing the great arc of the circle that in direct lines, winding about the 50th parallel of north latitude, will steam around the world, the resources of this great unknown become of immediate importance to our own Pacific slopes, and through them to the whole people of the United States. It was therefore with great satisfaction that I welcomed this the 5th volume of the series on The Industries of Russia, designed for the World's Columbian Exposition, and accepted the invitation of the Imperial Minister

of Finance to edit and supervise its translation into English. In full realization of its unquestionable interest and value to the American people I have laboured hard to make this Edition as faithful to the original as the very limited time and exigencies of the case would permit.

Together with an historical account of the conquest of Siberia, of the subjugation of the petty princedoms and nomads, with a glimpse of the colonization going on up to the present day, and with a review of the efforts of the Government to induce the various Siberian tribes to adopt settled modes of life and engage in regular industrial pursuits, will be found a full and scientific resumé of its flora and fauna, of its mineral resources, its possibilities of agriculture and trade, and of its climatic and physical characteristics.

This work contains also numerous official tables and statistics covering the several industries of the country, and is accompanied with a general map, showing among other matters of interest the various railway surveys that have been made, examined and rejected, as well as the line which now, in process of construction, winds its way along the rivers, over the mountains and across the vast plains on its way to the eastern shores, thus to form a through railway route from ocean to ocean in the Old as in the New World, to the mutual advantage of the two great and friendly nations, the Empire of Russia and the Republic of the United States of America.

To His Excellence, Mr. V. I. Kovalevsky, Director of the Department of Trade and Manufactures, Actual Councillor of State, and President of the Imperial Russian Commission, World's Columbian Exposition, ably assisted by Senator P. P. Semenov, Vice-President of the Imperial Russian Geographical Society, is due the well-earned credit and honour of formulating and of carrying out the original idea of His Excellence, Mr. S. J. Vitte, Imperial Minister of Finance, with reference to the preparation of this work, and of editing and publishing the same in the Russian language.

Although this volume, like all the others of this series, has been prepared in extreme haste and under very great difficulties, rendering it impossible to avoid errors, nevertheless, I trust the reader will find pleasure and profit in examining this authentic and official resumé of the present and future interests of that enormous and immensely rich country, Siberia, the Great East of the Russian Empire, separated only by pacific waters from the Great West of the United States, and which are destined in the near future to be in intimate commercial relations with each other.

J. M. Crawford.

St. Petersburg, August 15, 1893.

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RUSSIAN WEIGHTS AND MEASURES.

The following tables will serve to define the Russian weights and measures in terms of the French Metric System, as also those which are used in the United States.

I. Long measure.

The lineal measures of Russia have for a unit the foot, which, according to the laws of Peter the Great, is the same as the English foot.

1 Russian foot	= 1 English or United States foot.
»	= 12 inches = 120 lines = 1,200 points.
»	= 0·304794 metre = 30·4794 centimetres.
1 Russian arshine	= 16 vershoks = 28 inches.
»	= $2^1/_3$ feet = $^7/_9$ or 0·77778 yard = 0·71118 metre.
1 Russian sagene	= 7 feet = 3 arshines.
»	= 2·13356 metres = 213·356 centimetres.
»	= 2·3333 yards.
1 Russian verst	= 500 sagenes = 3,500 feet.
»	= 1066·78 metres = 1·06678 kilometres.
»	= 0·66269 English mile.
1 geographical mile	= 6·956 versts = 7·420 kilometres.
»	= 4·601 English miles

II. Square measure.

1 square sagene	= 49 sq. feet = 4·5521 sq. metres.
»	= 5·4444 sq. yards.
1 dessiatine (Russian land measure)	= 2,400 sq. sagenes.
»	= 1·0925 hectars = 2·6997 acres.
1 square verst	= 250,000 sq. sagenes = 104·17 dessiatines.
»	= 1·1380 sq. kilometres.
»	= 0·43916 sq. English mile.
1 square geographical mile	= 48·38 square versts.
»	= 55·06 » kilometres.
»	= 21·25 » English miles.

III. Cubic measure.

1 cubic inch	= 16·386 cubic centimetres.
1 cubic sagene	= 343 cubic feet.
»	= 9·712 metres.
»	= 12·704 cubic yards.

DRY MEASURE.

1 chetvert	= 8 chetveriks = 2·099 hectolitres.
»	= 5·9567 American bushels.
1 chetverik	= 8 quarts = 1601·22 cubic inches.
»	= the volume of 64 Russian pounds of water at $13^1/_3{}^0$ R. temperature.
»	= 26·238 litres = 0·26238 hectolitre.
»	= 0·7446 American bushel.

LIQUID MEASURE.

1 vedro	= $^1/_{40}$ of a barrel = 10 shtoffs or krouzhki = 750·57 cubic inches = volume of 30 Russian pounds of water at $13^1/_3{}^0$ R. temperature.
»	= 12·299 litres.
»	= 2·707 English or 3·249 American gallons.

IV. Avoirdupois weight.

1 berkovets	= 10 pouds = 0·1638 metric ton = 163·80 kilograms.
»	= 0·161217 English ton = 3·2243 cwt.
1 poud	= 40 Russian pounds = 0·01638 metric ton = 16·380 kilograms.
»	= 0·32243 cwt. or 32·243 Eng. lbs.
1 Russian pound	= 32 lots = 96 zolotniks = weight of 25·019 cubic inches of water at $13^1/_3{}^0$ R. in vacuo.
»	= 0·40951 kilogram = 409.51 grams.
»	= 0·90282 English pound.

TROY WEIGHT.

1 zolotnik	= 96 dolee.
»	= 4·2657 grams.
»	= 65·830 grains Troy.

V. Complex table.

1 rouble paper per dessiatine	= 19·06 cents per acre.
1 » gold » »	= 28·59 » » »
1 kopeck paper » poud	= 31·9 » » ton.
1 » gold » »	= 47·88 » » »
1 » paper » chetvert	= 0·0863 » » bushel.
1 » gold » »	= 0·1295 » » »
1 » paper » poud of wheat	= 1·282 » » »
1 » gold » »	= 1·923 » » »
1 chervert per dessiatine	= 2·2081 bushels per acre.
1 poud » »	= 13·377 English pounds per acre.
1 vedro » »	= 1·204 American gallons per acre.
1 kopeck paper per poud and verst	= 48.15 cents per ton and mile.
1 » gold » » » »	= 72·225 » » » » »

SIBERIA.

AND THE

GREAT SIBERIAN RAILWAY.

CHAPTER I.

Historical Sketch.

Geographical and administrative division of Siberia; historical review of its occupation, exploration and settlement; its subdivision into five large geographical regions; its administrative division; the first contact of the Russians with Siberia by means of the Stroganovs; annexation of a part of Siberia to Russia at the end of the sixteenth century; gradual occupation by the Russians of the whole of Siberia in the course of the seventeenth century; first attempts at navigating the Arctic Ocean, and the Behring and Okhotsk seas; appearance of the Russians upon the Amour; struggle with China for the possession of the Littoral-Amour country; the Nerchinsk treaty; beginning of permanent colonization of Siberia at the end of the seventeenth, and its gradual realization during the eighteenth century; establishment of frontier defense lines called forth by the necessity of protecting colonization; development of colonization under the shelter of these lines; scientific explorations by sea and land in Siberia in the eighteenth century; surrender of Russo-American possessions to the Government of the United States; acquisition of Sakhalin and surrender of the Kuril Islands to Japan; settlement and exploration of Siberia in the first half of the nineteenth century; annaxation of the Amour tract in the beginning of the second half of the nineteenth century; scientific explorations in the Amour Littoral country; gradual occupation of the Kirghiz steppe country in the course of the nineteenth century; annexation to Russia of the country of Semirechinsk and Zailisk in the beginning of the second half of the nineteenth century; significance and consequence of this fact so important to the history of Asiatic Russia; colonization of Siberia in the second half of the nineteenth century, and the position of the colonization question at the present time; recognition of the necessity of building a great railway through Siberia; visit to Siberia of the Tsarevich; and the foundation of the Siberian Railway Committee.

UNDER the name Siberia, in the most widely accepted meaning of the word, are understood all Russia's Asiatic possessions, with the exception of Transcaucasia, the Transcaspian territory and the Turkestan governor-generalship. Accordingly the Ural chain and river would appear to be the natural boundary between European Russia and Siberia. But the Ural chain, colossal in its linear extension, but not attaining any elevation and traversable almost imperceptibly in its lowest passes, with its mineral wealth scattered chiefly over its eastern slope, was never like other great mountain chains on the earth's surface, a separating barrier in the etnographical and economical life of the peoples, but on the contrary, from the time of the occupation of Siberia by the Russians, proved as it were, a line uniting European and Asiatic Russia.

The Transural districts of the Perm government, in which the mineral wealth of the Urals is most abundant, and which are the largest furnishers of grain to the Ural mining population, have long been reckoned not to Siberia but to European Russia. In like manner

also the steppe Ural and Turgai regions, passing far beyond the Ural river and penetrating deeply into the interior of Asia, are not counted as belonging to Siberia, because the centres of gravity of these regions, that is, their administrative centres, are situated in European Russia. Thus, Siberia is composed of the following parts: 1. Two governments of the basin of the river Obi, namely, Tobolsk and Tomsk, forming the so-called Western Siberia; these governments entered formerly into the composition of a special governor-generalship now abolished, but are at present governed, each separately, upon identical lines with the governments of European Russia. 2. Two governments of the basin of the Yenissei, namely Yenisseisk and Irkutsk, forming the so-called Eastern Siberia, in the strict sense of the term, and entering into the composition of the East Siberian governor-generalship. These two component parts of Siberia form the original Siberia, that is, that Siberia which was long ago and constantly occupied by Russian colonists, and where from eighty to ninety per cent of the population belong to the Russian race. The remaining parts of Siberia form those outskirts of the country, which from their very nature or from their remoteness are yet very little settled by the Russians and either occupied by primitive Asiatic or native peoples or are deserts and even absolutely uninhabited, and may be compared not with the states but with the territories of the United States. To these outlying regions of Siberia belong: 3. The Yakutsk region, constituting in respect to administration the Yakutsk territory alone. This, the most vast of all the Siberian territories, occupies the immense basin of the Lena and the less considerable basins of the smaller rivers, for example, the Yana, Indighirka and Kolyma falling into the Arctic Ocean. The Yakutsk territory in administrative respects forms a part of the East Siberian governor-generalship. 4. The Amour and Littoral region; this consists of three territories, constituting the Amour governor-generalship, namely Transbaïkalia, the Amour and the Littoral. These territories cover the whole of the Russian part of the basin of the Amour and the whole coast zone belonging to the basin of the Pacific or rather of the Japan, Okhotsk and Behring seas, including the vast peninsula of Kamchatka and the island of Sakhalin. 5. The steppe Kirghiz region; this consists of three territories, comprised in the Steppe governor-generalship, namely: those of Akmolinsk, Semipalatinsk and Semirechensk, in former times known under the collective name of the Kirghiz-Kaissak Hordes and Steppes. Composed as above, Siberia occupies the immense area of 250,000 square geographical miles, being twenty-five times greater than Germany and two and a half times Euporean Russia.

The annexation of Siberia to the Russian Empire took place at the end of the sixteenth century. The occupation by the Russians of this vast country was effected without any particularly bloody wars and hardly cost the Government an effort. The free Cossacks very rapidly conquered Siberia, and after them other intrepid seekers of booty poured in like a wave.

The principal pioneers in the occupation of Siberia at that time were adventurers, such as traders, sable hunters, trappers and fishermen. Organizing artels or societies they distanced by far the Government colonization, and scattered themselves over unknown wastes. In one spot they collected y a s s a k, or a tax on furs; in another they destroyed wild animals, and looked for fish and mammoth tusks; they drove off or bartered the cattle belonging to the natives; they established whole industries by collecting hops, cedar nuts et

cetera. In the steps of the traders followed the mound men or excavators of barrows (kurgans) for the precious objects contained in them. Under the influence of searches for riches the Siberian pioneers became transformed into vagabonds and nomad adventurers, so that the Government had afterwards to make great efforts to bind them to the land.

A short history of the conquest of Siberia may be marked by the following facts. The first raids upon the Yugra, a Finnish tribe, one inhabiting the present government of Tobolsk, were already made in the twelfth century by enterprising traders from Novgorod, whom the Yugra attracted by their valuable peltry. These raids, be it observed, had no character of conquest but always ended with the taking of ransom in the form of costly furs. More definite relations of the Russians to the Siberian peoples began only with the sixteenth century, namely, with the time when Russia, after destroying the Tartar kingdoms of Kazan and Astrakhan, took possession of the whole extensive basin of the river Volga, whose branches brought pioneers of Russian colonization into the depths of the Urals, with its abundant mineral wealth. Passing over the easily traversed Ural chain, these pioneers were bound to come into conflict with Tartar tribes, inhabiting or wandering over the region across the Urals, and under the powerful hand and protection of Ivan the Terrible began gradually to subject them, at first to their influence, and then to their sovereignty.

In the year 1555 ambassadors came to the Tsar from Yediger and other Siberian princelings, oppressed by their southern co-tribesmen, praying to be accepted as his subjects, agreeing to the imposition of a tribute on condition that he should send them some of his people. The Tsar assented, but such allegiance was very unstable as Yediger hoped that the protection and help of the Tsar would restrain his enemies from attacking his possessions, but these expectations were not realized. Not receiving the desired protection and help, and as hard pressed as before by his hostile neighbours, he began to pay his tribute irregularly, and on the accession to the Khanate of Kuchum this tribute ceased altogether, and the Russians who came for it were not infrequently killed. The firm allegiance of Transuralia only came about in consequence of the movement of the Russian population undertaken with industrial and commercial objects towards the north-east.

A great importance in the history of this movement attaches to the family of the Stroganovs. The Russian princes possessing vast tracts of unsettled lands, very willingly assigned them temporarily to enterprising and rich people on the condition that they should settle them and cultivate the land, the said pioneers being afforded every possible privilege, such as freedom from taxes, trade unfettered by duties, and the right of administering justice to the settlers. The Stroganovs with their great wealth appear as the chief settlers of the great north-eastern tracts. In the reign of Ivan the IV, these rich manufacturers and traders penetrated into the depths of the river region of the Kama, and in 1558 petitioned the Tsar to grant them land along the Kama to the Chussovaya on condition that they should build a town there, develop industry, raise troops and defend the region from the attacks of wild hordes. It was difficult for the Government to defend the Kama region with its own forces, on account of its remoteness, and at the same time it was constantly being subjected to attacks and forcible devastations on the part of the Cisural and Transural tribes. Therefore, the proposition made by the Strogonovs seemed very advantageous; their prayer was granted, all

kinds of privileges were given them for 20 years, and the settlers bound themselves to build stockades and to maintain troops at their own expense. A few small towns quickly appeared on the spot, industry increased, the Russian population grew and established itself firmly in places till then unknown to it. Thus, the Stroganovs, thanks to their vast resources and their intrepidity, enterprise and energy, not only consolidated the Russian sovereignty in the Urals, but gave Russian settlers the possibility of passing over to the Eastern side of the mountain range so richly endowed by nature.

Ceaseless collisions with the natives and the striving to develop their industry over a wider territory induced the Stroganovs to beg the Tsar to authorize them to settle places on the other side of the Urals also. The brilliant example of the settlement of the Kama district had demonstrated to the Government the advantageousness of undertakings of this kind. The permission was given, and the Stroganovs bound themselves by the same conditions as before, and were even empowered to wage war not only of a defensive but of an offensive nature. For more extended offensive operations the Stroganovs could not at once find enough armed men, but these were not long forthcoming.

In the second half of the sixteenth century, during the reign of Ivan the Terrible, a mass of people fled into Lithuania while not a few bent their steps into the waste regions forming the new acquisitions of Russia. There in those outlying regions the fugitives found liberty, ease and abundant space; whole bands were formed out of chance associates, who almost completely severed themselves from the State, paid but scant attention to the latter and lived their free Cossack life. But the Cossacks, engaged in robbery, harried also the territories which were under the authority of the Tsar, and were prosecuted by the Government for their brigandage. One of these parties of Don Cossacks, which had particularly destinguished itself by its freebooting expedition on the Volga, and which was being pursued by the Tsar's troops, proceeded under the leadership of its ataman Yermak Timofeev up the Kama and so reached the Stroganov possessions. The Stroganovs availed themselves of the opportunity and invited the Cossacks to enter their service. The latter consented and in a short time, equipped by the Stroganovs and with Yermak at their head, started across the Ural mountains and entered the limits of Kuchum's kingdom.

In 1580 Yermak was already on the banks of the Tura, defeated the Tartar princelet Yepancha, then took by storm the town of Shingi-Tura, upon whose site stands at the present time the town of Tiumen, and there took up his winter quarters. In the spring of the subsequent year Yermak moved on to the capital of Kuchum, the town of Isker or Siberia. Having navigated the Tura, Tobol and Irtych in barges, the Cossacks on October 26, 1581, reached the Khan's residence, and after a fierce fight took possession of it. Kuchum fled with the remains of his troops into the southern steppes. Yermak immediatety sent his trusty lieutenant and ataman, Koltso, with the news of this conquest to Moscow, having furnished him with costly furs and commanded him «to humbly salûte the Lord Ivan Vasilevich the Terrible with the acquisition of the new Siberian kingdom». The Tsar forgave Yermak his former faults, presented him with a cloak and medal, and sent the leader Glukhov to his assistance. Yermak Timofeev was however not long fated to rule Siberia. In 1584, enticed too far by the cunning of the Tartars, he perished together with his band in a fight upon

the banks of the Irtysh. In Moscow, meanwhile, nothing was known of the destruction of Yermak, and in 1586 arrived on the Tura a fresh reinforcement of 300 men under their leaders Sukin, Miasnov and Chulkov, who founded upon this river the town of Tiumen and thence began to spread the Russian authority over the Siberian natives. In 1587 yet another 500 troops were sent from Moscow into Siberia, and the order was given to build the Russian town of Tobolsk in the place of the ruined capital of Kuchum.

As soon as the Siberian kingdom was united to the Russian possessions the Government began to concern itself about the strengthening of the bond between the new possessions and the old. It could not have the extensive countries, seized by the Russians, deserted, and was compelled to move forth certain portions of its own population to create points of resistance, or so to say, cadres of the future natural colonization. Such points of resistance, founded beyond the Urals in the sixteenth century, were besides Tiumen and Tobolsk, Verkhoturie, Pelym, Beriozov, Surgut, Obdorsk, Narym, Ketsk and Tara. All these little towns served only as centres from which the conquerors were able to exploit the Siberian natives by means of collecting from them y a s s a k and trading with them in furs. In the seventeenth century the construction of rallying points continues, and Russian dominion rapidly extends further and further to the east. From the year 1604 the following strongholds were gradually built, out of which subsequently grew the towns of Tomsk, Turukhansk, Kuznetsk, Yeniseisk, Kansk, Krasnoyarsk, Yakutsk, Olekminsk, Achinsk, Barguzinsk, Irkutsk, Balagansk, Nerchinsk, Kirensk, and thus the Russian power was quickly extended over the basins of the three giant rivers of Siberia, the Obi, Yenissei and Lena. Between 1630 and 1640 Russian Cossack parties reached, on the one hand, the Arctic Ocean, and on the other, to the Sea of Okhotsk, and to this period belong their first attempts at sea voyages. In 1636 the Cossack Yellissei Buza was sent from Yenisseisk with the positive instruction to put to sea, and following along the coasts of the Arctic Ocean, to impose y a s s a k upon its inhabitants. Only in 1637 did Buza succeed in descending the Lena, coming out by its western arm upon the coast of the Arctic Ocean, and in making his way along it to the mouth of the Olenek. In the following year however, 1638, having built himself two vessels, called «Kocha», Buza sailed into the ocean by the eastern arm of the Lena and succeeded in reaching the mouth of the Yana. Almost at the same time Ivan Postnik reached the Yana and the more distant Inidighirka by land. In 1644 the Cossack Mikhaïl Stadukhin discovered the most eastern of the great rivers falling into the Arctic Ocean, the Kolyma, and there founded a winter station, subsequently transformed into Nizhni-Kolymsk.

From the extreme point of resistance at that time of the Russian dominion in the east, Kolymsk, a complete expedition was equipped in the year 1647 under the command of the Kholmogorsk emigrant, Fedot Alexeev and the Cossack Semion Dezhniev. In 1647 the expedition consisted of only four vessels; it reached the Chukotsk coast but did not succeed in penetrating further. On the other-hand in the following year, 1648, an expedition of seven vessels with more than ten men on each vessel, under the leadership of Semion Dezhniev, Fedot Alexeev and Gerassim Ankundinov, was more fortunate. Quitting the Kolyma on the 30th of June, the intrepid sailors found the sea free from ice, and without meeting with any particular obstacles weathered the cape, called in recent times by Nordenskjöld

Cape Dezhniev, sailed through the whole of the straits dividing Asia from America and subsequently called after Berend and gained the Chukotsk Cape. Here the expedition encountered a severe storm, during which Ankundinov's vessel perished, but his crew was distributed among the vessels of Dezhniev and Alexeev. On the 30th of September the Russians landed, but here had a skirmish with the Chukchis in which Fedot Alexeev was wounded. After this a frightful storm separated forever the vessels of Semion Dezhniev and Fedot Alexeev. Dezhniev bravely struggled in the open sea with storms and opposing winds, which bore him away to the south of the entry into the Anadyr bay, and finally he was cast upon the coast right beyond Cape Olliutor near the mouth of the river Olintora, that is, upon the limits of Kamchatka between 61° and 60° N. L. From there Dezhniev and his twenty-five companions made their way to Anadyr where he founded a winter station, which afterwards became the Anadyr stronghold, as hither arrived soon after by land Russians under the command of Semion Motora from the Kolyma. Dezhniev himself returned to the Kolyma not earlier than 1653. In the meanwhile Fedot Alexeev parted from Dezhniev by the storm, according to information collected subsequently by the describer of Kamchatka, Krasheninnikov, traversed, it would seem, the whole of Kamchatka and perished on the river Tighila, that is, on the western shore of the peninsula.

Only in 1697 Kamchatka was discovered afresh and occupied by the Cossack Vladimir Atlassov, who starting from the Anadyr stronghold, destroyed four Koriak towns and having founded on the river Kamchatka the stockaded fort of Nizhni-Kamchatsk reduced the whole of Kamchatka.

At the same time the movement of the Russians towards the coast went its course in more southern latitudes. After the foundation on the middle course of the Lena of the Yakutsk fort by Peter Beketov, parties of Russians began to ascend the Aldan and to reach the Stanovoi range. It was by this road, passing the Stanovoi range, that the Cossack Ivan Moskovitin's party, sent in 1639 to impose yassak upon all the Tungus tribes, came out upon the river Ud and so reached the Sea of Okhotsk. After this, stockaded forts were founded at the mouths of the Ud and Tungura, and in 1643 the Russians for the first time appear upon the Amour. Equipped by the Yakutsk voevode the elder Vassili Poyarkov with 130 Cossacks ascended the rivers Aldan, Uchur and Gonam, crossed the Stanovoi range and then came out by the Brianda and Zeya upon the Amour and, descending the river, sailed into the Sea of Okhotsk. In 1647 the Cossack Shelkovnikov crossed from the mouths of the Amour to the mouth of the river Okhota and here founded the fort of Okhotsk.

But it was the Cossack elder Yerofei Khabarov who specially distinguished himself by his exploits upon the Amour. This intrepid Cossack who had formerly occupied himself at one time with corn growing, at another with salt boiling, undertook at his own costs to subjugate the Amour country. Having received the authorization from the Yakutsk voevoda, he in 1649 and 1650 reached the Amour by the rivers Olekma and Tunghir, destroyed a few Daur cities and having personally convinced himself of the natural riches of the country visited by him, hurriedly returned to Yakutsk in order to there excite interest and attention to the hitherto unknown country which was so remarkable in every respect. Having mustered a party of volunteers to the number of 150 men, and having received three guns from the

voevode, in 1651 he again made his appearance upon the banks of the Amour and stopped to winter in the station of Albazin founded by him. During two years notwithstanding the opposition of the Manchuro who surrounded him on every side he occupied the whole course of the Amour and reported his success to Yakutsk.

The rumour of the wealth of the river conquered by Khabarov quickly spread not only through the Siberian voevodeships but reached the Tsar himself, so that in 1654 Khabarov was recalled to Moscow to make a personal report upon the Amour, and the whole of his brave company was placed under the command of the Cossack Onufri Stepanov. This worthy successor of Khabarov closely pressed by the enemy, was obliged to fortify himself in the newly built Kamora stronghold and in 1655 withstood a severe siege at the hands of a numerous Manchur army. Later, after three years of obstinate struggle with the Manchurs, he fell in a skirmish in 1658.

Meanwhile, a road to the Amour was opened through Transbaikalia. The Yenisseisk voevoda Pashkov proposed to the Government, for the expeditious subjugation of the Amour, to select in the vicinity of the steppes a rallying point, where all the warlike force might be concentrated and whence it might undertake offensive movements. His plan was approved and an expedition to the Amour was entrusted to him; at the same time all the detachments along the Amour were ordered to place themselves under Pashkov's orders. This voevode then, from Yenisseisk, following the Upper Tunguzka, Baikal, the Selenga and the Khilka, reached the river Nerch, and at a distance of four versts from its mouth founded in 1658 the Nerchinsk stockaded fort. Here he wished to gather all the Amour bands which had been under the command of Stepanov, but as upon the death of the latter these parties scattered, Pashkov did not venture, with the miserable remnants of those who answered to his summons, to undertake any decisive operations and thus his expedition met with no success.

In 1665 a crowd of Russians under the leadership of Nikifor Chernigovski consisting of fugitive criminals, wishing to earn their pardon, appeared upon the ruins of Albazin, renewed the fortress there, began to collect yassak from the previous tributaries, the Tunguzes, and founded some strongholds. In 1677 the fort Verkhozeissk was built on the upper waters of the Zeya, followed by forts Selimbaevsk and Dodonsk. For almost 20 years Albazin enjoyed comparative tranquillity, but in 1685 the Manchur troops, with considerably superior forces, devastated the environs of Albazin and from the 12th of June of the same year commenced the celebrated siege of this town. The voevode Tolbuzin, with a body of 500 men pitched against a horde of 15,000 Manchurs, was obliged to surrender Albazin and retreat; but in the same year, reinforced by fresh troops that had come to his aid, he returned and built upon the site of the burnt wooden fortification an earthern entrenchment. The Manchurs observing the restablishment of Albazin undertook a second siege in 1686, during which Tolbuzin was killed and his successor Afanasi Beiton stubbornly continued to hold his earthworks for a whole year, until at last in 1687 the exhausted Manchurs were themselves compelled to raise the siege. In 1688, a congress was appointed of the plenipotentiaries of the two warring sides, at which the Chinese gained a diplomatic victory. In August 27, 1689, the Nerchinsk treaty was signed, confirming the Amour to the Chinese, and for 160 years depriving the Russians of the possession of this outskirt of Siberia.

Only from the end of the seventeenth century when the boundaries of Siberia in the large sense of the term were already indicated more or less by the points of defense, could the actual permanent colonization be effected; the Government besides building cities and y a m a s, or posting stations, strove to create a class of peasant artisans and to spread corn growing. With this object, by command of the Tsar Feodor Alexeevich, volunteer ploughmen were sent from Solvychegodsk and other towns of the Permia of that time, who received besides every kind of privilege, agricultural implements and assistance in money. The road of the first settlements lay by the rivers Tura, Tavda, Tobol, Irtysh, Obi and their tributaries. The emigrants cut into the very heart of the native population; the Chudic tribes thrust back in the fifteenth century by the Tiurks people, themselves pressed forward by the Mongolian movement and known by the general name of Tartars, remained in their places. From the south the greater part of the Tartars had wandered away further into the depths of the steppes, while the Ostyak and Samoyed tribes were moved back to the north and east.

The Government had to concern itself with the provisioning of the people it had settled, who required to be supplied with everything. Grain was imported from Perm, Viatka and Solvychegodsk. In consequence of the bad roads the furnishing of provisions was delayed, and hence Government servants suffered terrible want. The merchants occupied themselves with the furnishing of the colonists with goods. But trade relations of the new country with its metropolis Moscow were very difficult and were effected but once a year. Communications were accomplished by means of the rivers. The wares were transported on barges or plank levats. The Siberian sledges called «narta» were dragged over the portages by men. The merchants sometimes took up winter quarters on their way. The method of trading was slow and therefore only a few dealers penetrated into Siberia, but having reached there, from the absence of competition, became at once monopolists.

The spread of agriculture and the establishment of fixed settlements within the limits of the new country were supported by the sending out of ploughmen, post drivers, and with them girls to be married to the Cossacks, and also by the alleviation of the burdens imposed by the voevodes. By the care of the Government the growing of grain was spread not only among the Russian population but among the Tartars and Voguls of the present Tiumen and Turinsk districts. The agricultural population having dotted the country with villages formed the chief foundation of colonization in the east. It may be said that the true foundation of life in the region was laid when the conqueror's first grain of corn fell into the soil of the conquered countries.

Beginning with the end of the seventeenth century, this permanent colonization obtained in the eighteenth a more regular form. The Government, settling the unoccupied spots, at the same time took care to secure them from the raids of the nomads, who had been driven back into the steppe regions of Central Asia, and which were so frequent and so destructive to the young colonies. Such raids indeed arrested the development of agricultural settlements in Siberia and Zavolzhia not only in the end of the seventeenth but also in the first half of the eighteenth century. To protect the colonization as yet not firmly established, the fortresses of Omsk, Yamyshevsk and Petropavlovsk were built, as well as among others the towns of Biysk, Semipalatinsk and Ust-Kamenogorsk.

As at the very beginning of Russia's acquaintance with Siberia the enterprise of private persons had a great significance in the movement of the Russians eastward, so in the beginning of the eighteenth century no slight services were rendered the Government by the rich trader Akinfi Demidov. In 1723 his parties penetrated, with trading and industrial objects in the Altai mountains to Mount Siniukha near lake Kolyvans, and here found Chudie mines and traces of ores. In 1726 artisans and clerks were sent here by Demidov from his Nevian works in the Urals, and on the small stream of the Loktevka falling into the Allei was built the first works, called Kolyvansk. Soon other mines were discovered in the neighbourhood of whose existence Demidov presented a report to the Government and by an ukaz of the year 1747 the works of Kolyvansk and Voskresensk were taken over from Demidov by the Crown.

With the development of mining in the Ural, Altai and at the Nerchinsk works, there was required an increased number of workmen. To meet this demand hundreds of families were sent forth from the interior of Russia to the works and attached to the latter, and in this way the Russian population of Siberia grew every year.

To unite the limits of conquest already indicated by stockades and fortresses to intermediate points as also for the defense of the mining works from the raids of nomads, the tracts or main routes were settled, and Cossack defense posts and settlements established. In 1744 to 1745 the tract between Tobolsk and Tara was so inhabited, followed by those between Ishim and Omsk, and the Chauss stockade and Tomsk. In 1762 to 1780 the tract between Tara and the Chauss stockade was settled, and in 1763 the Ekaterinburg road was built. Among the Cossack defense lines in 1720 to 1773 was constructed that of the Irtysch, in 1755 that between Omsk and Zverinogolovsk. Further, with the movement of colonization into the depths of the Altai, the Kolyvan-Kusnetsk, Novokolyvan-Kusnetsk, and in 1780 the Bukhtarminsk lines.

Parallel to the colonization patronized by the Government, at times during the critical moments in Russia's historical and economical life, another kind of colonization, namely, secret colonization was effected.

The government of Tobolsk, as the first zone lying on the road to the little known country, was more thickly populated with fugitives belonging to those groups of the population of European Russia who were there faring ill. In Siberia these fugitives under the protection of dense forests and swamps raised their solitary dwellings, made so-called «zaimkas» or enclosures, cleared forests and introduced tillage. The voevodes on discovering such settlements did not destroy them but only levied upon them state taxes. Such emigrants, settling and at the same time securing the possession of an alien region, were not without their advantages to the voevodes. Thus the acceptance with an amnesty of the allegiance of the so-called Bukhtarmin masons, the fugitive families of dissenters and criminals who had taken up their abodes beyond the Kamen, one of the ridges of the Altai, spread the dominion of Russia to one of the best valleys of the Altai.

With the extension of the settlements the people became acquainted with the surroundoing spots and finding more convenient places, built themselves new outlying hamlets and suburbs. Each settled upon a separate patch over which he had arbitrary control; when, however, he did not wish to remain any longer in the same place, he handed over his land to another and sought a new home.

Such secret colonization at times attained fairly considerable dimensions, so that the State authority had to take severe measures to stop this undesirable movement.

Together with the settlement of Siberia in the course of the eighteenth century appeared the necessity for its exploration. The Emperor Peter the Great becomes the initiator in this matter, as in everything else. Recognizing that the attempts to establish regular sea communication with Kamchatka in place of the distant and circuitous road through the northern tundras, did not succeed, from the inability to build ships, he sent on this account Swedish prisoners acquainted with ship building to Okhotsk. On a ship built by Henry Busch the first attempt was made in 1716, and in 1717 took place the perfectly successful voyage of the Cossack Sokolov, after which regular communication between Okhotsk and Kamchatka was established. Next, Peter the Great was interested in the question of whether there is a passage into the Arctic Ocean between the Asiatic and American continents, the solution of this question by the voyage of Dezhniev being unknown to the Emperor. He equipped for the purpose of deciding this question a great Northern Expedition, under the command of the Danish sailor in the Russian service, Vitus Berend, Lieutenant Shpanberg and Alexei Chirikov. The expedition started from St. Petersburg in the year of Peter the Great's death, 1725, and only after three years reached Kamchatka through Siberia. Berend sailed out into the sea from Nizhni-Kamchatsk on the 31st of July, 1728, on the 19th of August, approached the Chukot peninsula under 64° 30′ N. L., on the 21st of August discovered the island of St. Lawrence and on the 26th of August saw under 67° 18′ N. L. the north-eastern extremity of Asia, Cape Dezhniev, and considering the question of the existence of a strait between Asia and America completely solved, returned to Nizhni-Kamchatsk. Berend's successful voyage did not remain without consequences.

The Russians commenced a whole series of attempts with the object of exploring the coasts of the Arctic Ocean and thus discovering a passage through it to America. In 1739 the expedition of Lieutenant Pronchischev fitted out for the Lena had imposed upon it the problem of exploring the seacoast between the mouths of the Lena and the Yenissei. But the expedition only succeeded in getting as far as the mouth of the Olenek and Pronchischev himself and his wife died on the desert shore of the ocean. The expedition of Lieutenant Laptev, which followed next, succeded in reaching the Taimir peninsula, namely, to Cape St. Thaddeus, but was not able to weather Cape Cheliuskin and Laptev's companion, Cheliuskin, was obliged to survey it only from the land side. At the same time, that is, in 1739 to 1740, Lieutenant Dmitri Laptev was commissioned to describe the littoral to the east of the mouth of the Lena. Only after these two years efforts did Laptev, passing by the Medviezhi Islands, reach Cape Baranov, but was unable to make the passage into Behring Strait.

Irom 1733 to 1743 belongs the remarkable scientific land expedition fitted out to explore the whole of Siberia under the guidance of the best men of science of the time, the naturalist Gmelin, subsequently author of the first Siberian Flora, and the historian Müller, the author of the History of Siberia. Into the composition of this remarkable scientific expedition entered also the astronomer Delille, Professor Fisher, assistant Steller, several students and geodesists. The expedition returned from Yakutsk, but Delille, Steller and the student Krasheninnikov

reached Kamchatka. Delille and Steller formed part of the second Berend expedition, equipped by the Government in 1740, which on this occasion had for its principal object the problem of exploring the north-western shore of America. Berend and Chirikov commanded the two vessels of the expedition. On the 15th of June, 1741, both vessels left Petropavlovsk for Kamchatka, but on the first of July a storm separated them. Berend reached the American shore between 68° and 69°, in view of the marvellous giant volcano of St. Elias. Then after a long and tiring voyage along the line of the Alleutian islands, Berend, sick and tortured by his voyage over the stormy sea, suffered shipwreck on the 5th of November at an island called subsequently by his name, and died after having landed, on the shore of the island. Lieutenant Waxel and Steller, having built a new ship from the fragments of the old, returned to Kamchatka after fourteen months voyage. Chirikov's vessel reached America much further to the south, under 56° N. L., that is, opposite the island Sitkha; but having lost two of his boats with their crews, destroyed by the natives on landing, sailed along the American coast, not putting to land anywhere, and with frightful losses from scurvy to which Delille fell a victim, returned to Kamchatka. The best result of the expedition were the splendid observations of Steller, who with Krasheninnikov composed the first descriptions of Kamchatka. But the practical results of Berend and Chirikov's expedition were the gradual discovery and occupation by the Russians of the north-western part of the American Continent. Thus, in 1743 the Russian trader Bassov already wintered upon Behring Island, and from 1745 to 1764 all the Alleutian islands were discovered and occupied. Much greater success attended the expeditions of Captain Shpanberg and Lieutenant Walton in 1738, 1739 and 1742, from Okhotsk to Japan and the Kuril islands.

In the second half of the eighteenth century, during the reign of the Empress Catherine II, began a new and brilliant era in the history of the geographical and scientific explorations of Siberia. The Yakutsk merchant Shalaurov, one of the prominent local Siberians, having equipped at his own cost a sea expediton, having for its object the passage into Behring sea from the mouth of the Lena, doubled in 1761 the Holy Noss and discovered the neighbouring island of Liakhov one of the new Siberian group. In the course, however, of the three years, 1761 to 1763, he was unable to penetrate to the east further than Cape Shelag, upon which he met his death during his second expedition undertaken in 1766. At the same time in consequence of the indications of the existence of lands in the Arctic Ocean, which had been known from the times of Dezhnlev, attempts were made to reach these lands in winter on sledges over the ice. One of such successful attempts was the journey of Sergeant Andreev, who discovered in 1763 a whole group of islands upon which he found traces of former habitation by people acquainted only with the use of stone implements and unfamiliar with the metals. This group of islands in the opinion of Nordenskjöld was Wrangel land. In 1770 the discoveries of the Russians touched the group of the New Siberian islands. In that year Liakhov not only investigated the island subsequently called by his name, but went as far as Kotel island.

The particular attention of the enlightened Government of the Empress Catherine was directed to the scientific exploration of the southern colonizational zone of Siberia. Among the expeditions which marked an epoch in geographical science, equipped by the Academy of

Sciences at the desire of the Empress Catherine II, for the many-sided investigation of the little known parts of the Empire, the expeditions into Siberia, accomplished in 1770 to 1774 by the Academicians Pallas and Lepekhin, take almost the first place on account of their scientific value.

The attention of the Empress was also directed to the extreme east with its Behring Sea and north-western corner of America. The expedition fitted out by the Government in 1768 to 1769 under Captain Krinitsin and Lieutenant Levashov, visited the Alleutian islands and gained A l a s k a. In 1789 the trader Pribylov discovered the island, called by his name, and it has since become the centre of the sealing and whaling trade in Behring Sea. From 1790 to 1794 Captain Billings and Lieutenant Sarychev's expedition quickly regulated the developing and too rapacious fishing of the Behring Sea. In 1792 a private company, consisting of Deliarov, Shelekhov and Golikov founded the Russian settlement in Paul harbour upon Kadiak island, and in 1796 Novoarkhangelsk, on the island of Sitkha, upon which Russian authority was firmly established by Baranov, only in 1799. Similar permanent settlements arose also upon several of the Alleutian and Commandor islands and even upon the peninsula of Alaska, then consisting of the Alleutians.

In 1799 a great company was organized in St. Petersburg under the name of the Russian American Company with the object of working the Russian possessions upon the American Continent, as also the shores and islands of Behring Sea and of the Sea of Okhotsk. The company was granted very ample privileges, to secure which the Government recognized it as necessary to conclude a convention with the United States in 1820, and with Great Britain in 1825. The term of the privileges was originally fixed for twenty years but it was subsequently several times renewed, so that the Russss-American Company continued to exist till 1867 and was compelled to liquidate its affairs only in consequence of the surrender of the Russian American possessions with the Pribylov's islands to the Government of the United States. The Emperor, as is said in the treaty concluded on this subject on the 3rd of May, 1867, wishing to cement the good understanding existing with the Government of the United States, surrendered to the latter the whole territory with the sovereign rights thereto, then held by His Majesty on the American Continent, as also the adjacent islands.

Simultaneously therewith arose the question of the inconveniences of joint dominion over Sakhalin with Japan, and wishing to put an end to misunderstandings which arose in reference to this subject, it was recognized as advantageous to enter in 1875 into an agreement with Japan. The result of this agreement was the conclusion of the treaty with Japan of the 25th of April, 1875, upon the mutual surrender on the part of Russia of the group of the Kuril islands and on the part of Japan of the island of Sakhalin or Krafts. From this time the whole island of Sakhalin came under the sway of the Russian sceptre.

With the nineteenth century, when a complete administration and civil government was formed in Siberia, it became extremely difficult to wander freely over the country or to conceal oneself. The passport system and the prohibition of founding settlements or villages, without authorization fettered the emigrational movements, keeping them within narrower limits. But on the other hand, when the Government opened an issue to colonization it poured in like a wide torrent.

In the first half of the nineteenth century, as in the eighteenth, much attention was directed by both the Russian Government, and by Russian men of science, to the exploration of Siberia from both a geographical and scientific point of view. In the Arctic Ocean, Sannikov in 1805 discovered in the New Siberian group, the Stolbovoi island, and Bielkov, the Bielkov island and New Siberia. In 1809 to 1810 the first scientific expedition was undertaken for the exploration of the New Siberian islands, by order of the Chancellor Count Rumiantsev under the leadership of Hedenstrom. In 1821 to 1824, expeditions for their exploration were ofitted out under the command of the best Russian navigators in two parts of the Arctic Ocean, situated wide apart from each other. One of them under the command of the energetic sailor Littke, subsequently Count and Vice President of the Russian Geographical Society, attempted during four successive years to reach the Siberian Frozen Ocean, at one time trying to double Nova Zembla, at another striving to force its way into the Kara sea through the Kara gates, but without success. Extremely valuable investigations, on account of their scientific results, were carried out at the same time by the expeditions under Captain Wrangel and Lieutenant Anjou in the eastern part of the Siberian Frozen Ocean, between the mouths of the Lena and Kolyma. Behring Sea was also circumstantially explored by the two celebrated Russian navigators Kotsebu, 1815 to 1818, and Littke, 1826 to 1829.

The Russian Government was still more concerned about the exploration of the southern area of colonization. The expedition of Ledebur, Meier and Bunge in 1826 made an excellent investigation of the peculiar and interesting flora of the Altai and the expedition under Humboldt, Rose and Ehrenberg, fitted out by the Emperor Nicholas I, did the same for the geological formation of the Altai tableland. Local men of science also and observers did much for the sciences in Siberia. In the beginning of the thirties, Dr. Gebler in the Altai and Turchaninov in Circumbaikalia made excellent studies, one of the entomology and the other of the flora. The Altai, town of Barnaoul, the centre of the government of the Altai mining district, due to the solid scientific foundation of the mining engineers living there, became one of the three principal centres of culture of Siberia, thanks to which the metalliferous position of the Altai was well explored in geological respects. Between 1842 and 1845 two important scientific journeys were undertaken into Siberia, that of Peter Chikhachov, into the least accessible parts of the Altai, and that of Middendorf, to two little known and little explored outskirts of Siberia, the Taimir peninsula in the extreme north, and the coast of the Okhotsk Sea as far as the Shantar islands. Middendorf reached the latter region by following the southern slope of the Stanovoi range, which became a Russian possession only subsequently, namely in the early years of the second half of the nineteenth century, in consequence of the annexation to Russia of the whole Amour tract.

This great achievement in the history of Siberia owed its accomplishment to the extraordinary energy of the then Governor-General of Eastern Siberia, Muraviov, afterwards known as Count Muraviov Amoursky. Immediately on his arrival in the region committed to his care, Muraviov clearly perceived that Eastern Siberia with its vast region of Yakutsk, quite unfitted to permanent settlement, had very small prospect in the future, without the gigantic and sole river in Siberia, flowing its whole course from west to east, which leads to a sea not eternally closed by ice. To seize the whole course of this river was the task which Muraviov

firmly and carefully set himself about when he began the administration of the country entrusted to him. The first step for the attainment of this object was to avail himself of the transport «Baikal», sent by the Government already in 1848 to carry cargoes from the Naval Department to Petropavlovsk under the command of Captain Nevelskoy. He accordingly imposed upon this sturdy and enterprising sailor the discovery and exploration of the mouth of the Amour. Having received but an authorization, limited by various conditions, Muraviov found in Nevelskoy an excellent performer of his plans. Nevelskoy having landed his cargo in Petropavlovsk on the 31st of May, 1849, started with the transport Baikal for the eastern shore of Sakhalin, thence to begin his explorations. He doubled the northern extremity of the island, entered the bay of Obman, called it after the name of his transport, and making further investigations on the 28th of June, entered the frith of the Amour. He soon found the mouth of the river. A few days afterwards Nevelskoy entered the straits between the Continent and the western shore of Sakhalin at the Capes called by him Lazarev and Muraviov. Thus, contrary to the opinions of La Perouse, Krusenstjern and others, Sakhalin proved to be an island. After forty-five vain efforts to enter with the transport Baikal the mouth of the Amour, he turned back northwards into the sea of Okhotsk.

From this time the question of the annexation of the Amour obtained more serious signification in Government spheres. In 1850 the Amour expedition was formed, having for its chief object the foundation upon the shores of the Sea of Okhotsk near the frith of the Amour, at a point for the establishment of relations and trade with the Giliaks, and Nevelskoy was appointed commander of the Amour expedition. On the 29th of June he founded in Fortune Bay the Peter winter station, and in August he first hoisted on the shores of the Amour the Russian military flag, declared to the Giliaks that they were coming under Russian protection and founded at this point, twenty-five versts from the mouth the post of Nikolaevsk. Between 1851 and 1853 were founded the posts of Ilinsk at the mouth of the river Kusunaya, Alexandrovsk in the bay of De Castri and Mariinsk near lake Kizi.

In 1854, thanks to his repeated requests and perseverance, Muraviov received the Imperial authorization to «navigate the Amour». The Chinese government was warned of the intended first voyage on the river and without waiting for any answer from it, the small but powerful flotilla under the command of the Governor-General himself solemnly took the waters of the Amour on the 18th of May, descending to this river from the Shilka. On the 14th of June the expedition already reached the pool of Mariinsk, and thus the road was opened from the Russian upper waters of the Amour to the lower reaches of this great river only just occupied by the Russians.

The success of this first expedition marks an important epoch in the history of Siberia. The convenience and possibility of the settlement of the shores of the Amour, on account of the sparsely inhabited condition of the country, the peaceable character of the natives and the weakness of the Chinese, were demonstrated. The importance of the acquisition of the Amour was proved also by the fact that thanks to the sending in good time of provisions and arms to Kamchatka the port of Petropavlovsk was saved. Near this port the Anglo-French fleet stood in Avvachinsk bay with distinctly hostile intentions, and even opened fire upon the fortifications. Attempts of a similar nature were made in the following year but also without success.

In 1855 Governor-General Mouraviov laid upon his successor General Korsakov the task of the immediate and rapid realization of a Russian colonization along the course of the Amour. Emigrants were invited from the governments of Irkutsk and Zabaikal and owing to the numerous advantages offered in the form of liberation from military service, State provision for two years and the supply of agricultural implements, the number of applicants proved far greater than was at first thought necessary.

The flow of emigrants and arms continued during the following years, notwithstanding the expressed dissatisfaction of the Chinese authorities and in the meanwhile the diplomatic negotiations led to no results, due to the voluntary dilatoriness of the Chinese officials.

At length a project of a treaty was composed at Aigun in 1857 and handed to the consideration of the Chinese Government. In order to reserve himself the higher authority in the case of any misunderstanding General Mouraviov entrusted the ultimate direction of the negotiations to Perovski and thanks to the firmness of the latter the treaty was signed on the 16th day of May. The left banks of the Amour from Argun to the mouth were ceded to Russia and the right banks as far as the Ussuri, to China; only Russian and Chinese vessels were allowed to navigate the Amour, Sungari and Ussuri; the Mandzhurian inhabitants of the left banks of the Amour, from the river Zei on the south to the village of Harmandzin were to remain in their former places of habitation, under the rule of a Mandzhurian governor, there was to be free trade along all three rivers. These were the conditions of the Aigun treaty.

In order to enjoy the full advantages of this treaty it was necessary to colonize the province of the Amour; to cultivate a Russian population in it and to open a steam navigation along the Amour. And hence the Government came to the conclusion that it was necessary to institute an obligatory Cossack colonization of the Amour, Ussuri, and of all the region of the Ussuri. In 1858 Cossack stations were established along the left banks of the river from the beginning of the Little Hingan mountain range to the mouth of the Ussuri, and a Cossack colony was founded at the junction of the latter with the Amour, named after the first conqueror of the Amour, Khabarovski; this was followed by the colony of Blagoveschensk at the mouth of the Zeï, of Sophisk and others. And in this manner the Russian rule over the vast region of the Amour, was ultimately established. In 1860 there were already as many as twelve thousand colonists of both sexes in the province of the Amour and there were 61 Cossack stations. In the same year Count Ignatiev after prolonged negotiations with the Chinese Government succeeded in concluding the Pekin treaty by which the Chinese Government ultimately recognized the Russian rule over the river Amour and the entire region of the Ussuri. This treaty also confirmed all the points of the Aigun treaty and of the Tiantsin treaty previously made by Count Putiatin with the Chinese.

The occupation of the Amour was followed by a scientific survey of the Amour-Littoral region. This was inaugurated by the Russian Geographical Society, which in 1858 had opened an Eastern Siberian branch at Irkutsk. In 1854 the Society equipped its great Siberian expedition for the exploration of the regions of the Baikal, and especially of the Amour Littoral province. This expedition included the astronomer Schwartz, naturalist Raddey, geologist Schmidt, the envoy of the Eastern Siberian branch, R. Maack, and also the envoy

of the Academy of Sciences, Shrenk, zoologist, who was sent at the initiative of the Grand Duke Constantin, then President of the Academy, and lastly the envoy of the Botanical Gardens, Maximov, botanist. This expedition rendered incalculable service to the scientific knowledge of the region. The Eastern Siberian branch which subsequently became the most prominent local centre of culture in Eastern Siberia and its frontiers did not cease its useful activity, and at a later period the district was explored in all parts by local scientists sent under the protection of the Society and at its expense. Among these explorers mention may be made of Chekanovski, Dybovski, Potanin, Yadrintsev, Kropotkin, Cherski, Ditmar, Korzhinski and many others.

In general, during the last thirty years, an independent effort is already observable on the part of the local Siberian magnates to investigate the productive powers of their vast country. Among those persons who have enriched themselves by a prudent exploitation of the natural wealth of Siberia there are many who have shown themselves the patrons of every scientific exploration and daring enterprise which could bring advantage to Siberia. Some of these persons, like A. M. Sibiriakov and M. K. Sidorov have spared neither labour nor money for the exploration and discovery of a sea route to the mouths of the Siberian rivers, while others like I. M. Sibiriakov and Iukachev have spared no expense for the support and even equipment of scientific expeditions to the little known Siberian outlying provinces and adjacent parts of Central Asia, to the exploration of which the Russian Geographical Society has given particular attention.

During the last twenty-five years not only Russian, but also Scandinavian, English and American navigators, have been greatly attracted by the question of the investigation of the climatic conditions of the Arctic Ocean with the object of establishing a regular sea route to the mouths of the great Siberian rivers. As early as 1868 and 1869 the first successful endeavours to penetrate into the Kara sea were made by Swedish traders. The most convenient time of year for this was found to be the early autumn, when the Kara sea is most free from ice. Nordenskjöld's scientific expedition in 1875 showed that the mouth of the Yenissei is accessible in autumn, naturally for a very short time, and with the exception of particularly unfavourable years; and that for trading purposes it would be necessary to erect warehouses at the mouth of the river where the unloading and loading of the vessels could be effected in a few days. In 1873 to 1879 Nordenskjöld's famous expedition was equipped with the active cooperation of the Siberian magnate Sibiriakov. This expedition was the first to succeed in navigating along the entire Siberian coast and passing through the Behring straits into the Pacific Ocean. This expedition which extended over a space of two years, was naturally a triumph to science, but as yet it only proved, that although it is possible under particularly favourable circumstances to navigate through the Arctic Ocean along the entire Siberian coast, even in one year, yet with the exception of the above mentioned access to the mouth of the Yenissei, this coast cannot serve for regular maritime or mercantile relations. The heroic endeavours of the last American expedition under Captain Long, whose vessel the «Jeanetta» was lost on the coast of the Novo-Sibirsk islands and the survivors only saved after the death of Captain Long by Russians at the mouth of the Lena in 1881, proved the same truth. In the meantime the climatic conditions of the entire Arctic Ocean have now been

considerably enlightened by a large international enterprise, namely by the simultaneous observations of a series of polar meteorological stations erected in 1883 to 1884 on a common plan, with the consent of many Powers along the shores of the Arctic Ocean. Two of these stations were erected by the Russian Geographical Society, one at the mouth of the Lena, the other at Nova Zembla. The Russian Academy of Sciences also took advantage of the staff of the Lena observatory, for a new scientific exploration of the Novo-Sibirsk islands in 1885 under Bunghe and Baron Toll.

The opening of the Tomsk University in 1888, thanks to the large donations of the Siberian magnates, A. M. Sibiriakov and Tsibulski, made Tomsk a third centre of culture within Siberia proper and greatly aids the direction and development of the young scientific forces in the depths of Siberia.

The Russian rule has also gradually advanced into the depths of Asia on the other frontier opposite the Arctic Ocean, namely the Kirghiz steppes. This movement was started as early as 1731 by the acceptation of the Little Kirghiz Horde into the Russian rule. The fall of the Dzhungar kingdom to the Chinese in 1769 deprived the Kirghiz Kaissacks of a firm ally and obliged them to ultimately gravitate towards Russia. The daring and clever Khan of the Central Kirghiz Horde, Albai, managed to preserve the nominal independence of his people by artfully playing between China and Russia. But after his death in 1781, the feeble character of his successor Bali-Khan and the constant disputes among the different Kirghiz tribes and hordes resulted in one tribe after another seeking salvation from the oppression of its neighbours by submitting to the sway and powerful protection of Russia. These neighbouring tribes, placed, as it were, between the hammer and the anvil, between the plundering onslaughts of their still independent neighbours, on the one hand, and the Russian protection of its already subjected tribes on the other, sought the Russia rule, one after another. Such a gradual subjection of the Kirghiz steppes obliged the Russian Government to advance its foreposts far beyond the Irtysh into the depths of the Kirghiz steppes.

Between 1824 and 1834 the first Russian settlements were founded in the steppes of the Kirghiz of the Siberian department; the number of these settlements afterwards increased, but between 1836 and 1847 the successes of the Russian rule over the Kirghiz steppes, were hindered by a ten years struggle with the energetic grandson of Khan Ablai, the sultan Kenissara, who succeeded during ten years to play between the two neighbouring Russian Governor-Generals, on the one hand, and the independent Turkestan rulers on the other, until at last he fell in an insignificant dispute at the hands of his nomadic neighbours, the Karakirghiz, in 1847. Unfortunately the Russian settlements in the country of the Central horde were founded in places quite unfit for a settled agricultural life, for example, Bayan-Aoul, Karkarala, Akmolinsk, Atbassar et cetera, and could not therefore serve as points of support for the Russian control over the steppes of the Kirghiz limits of Siberia. But as soon as the beginning of the forties the explorations made by Russian naturalists and geologists, such as Karelin, Kirilov, A. Shrenk and Vlangali, showed that not all of the country is unfitted for settlement, but that on the contrary, at the foot of the Tarbagataia and Semirechinsk Altai, there are excellent and convenient lands for agriculture and colonization. Since the subjection in 1847 of the Great Kirghiz horde, whose lands were situated along the beautiful and fertile slopes of the Semi-

rechinsk and Zaïliisk Altai, it was found possible to start a settled and agricultural colonization in the south-east corner of the Kirghiz lands. Thus in 1847 the town of Kopal was built at the foot of the Semirechinsk Altai, and in 1854 the fort of Vernoie on the slopes of the Zaïliisk Altai, and subsequently, a whole series of considerable settlements were founded along the foot of this mountain chain.

The occupation of the Zaïliisk slopes was of similar importance in the history of Asiatic Russia to that of settling the region of the Amour. As soon as Russian colonization had set a firm foot in this frontier land of Central Asia, the pioneers of Russian science precipitated themselves thither. In 1855 to 1857 and the following years, the Russian Geographical Society equipped its first expedition under the direction of its Vice-President Semenov to this region, and subsequently used every endeavour for a scientific exploration of not only this region, but taking it as a starting point, for a gradual exploitation of the natural treasures of the interior of Asia. The names of the most active agents of the Russian Geographical Society are connected with the exploration of this region of Siberia and of the adjacent countries of Central Asia. After Semenov's expedition, Severtsov, Veniukov, Baron Osten-Sacken, Moushketov, Romanov, Przhevalski, Potanin, Beresovski, Pevtsov, Gromchevski, the brothers Groom-Grzhimailo, Krasnov, Bogdanovich, Obruchev and Roborovski appear as the pioneers of science not only in this region but in the depths of the Asiatic deserts and their oases and hills. In the interim Vernoïe, with its excellently colonized area, not only became the lever point of Russian influence over the neighbouring nomadic tribes, which soon voluntarily subjected themselves to Russia, but it also succeeded in binding such a knot of relations with the long settled rulers of Turan as could never have been done from the distant Orenburg.

In the meanwhile, in 1858, the fort of Perovsk was erected on the lowlands of the Syr-Daria on the spot taken from the Kokand tribe of Ak-mecheti and a line of outposts established along the Syr-Daria from Perovsk to Kasalinsk. At the end of the fifties the Russian Government gradually came to the conclusion of the necessity of advancing the frontier to include the tribes which had gone over to Russian rule, and of entirely subjecting the Kirghiz hordes far into the Kirghiz steppes, with the kingdoms of Turkestan, and of occupying the slopes of the mountain chain limiting the upper course of the Syr-Daria on the north between the meridians of the already occupied limits of lake Issyk-Kule and fort Perovsk. This occupation which was begun by Colonel Tsimmermann in 1860, and realized by Colonel Cherniaev in 1864, resulted in the subjection of Tashkend, gradually brought the whole of Turkestan under Russian rule and was completed in 1881 by the occupation of the present Transcaspian province to the very frontiers of Persia and Afghanistan and the laying down of the Transcaspian Railway.

The colonization of Siberia proper has followed its natural course. The emigration movement was very strong before the Crimean campaign; then in 1855 it decreased, but after the close of the campaign it again increased. Before 1861 at the time of the liberation of the serfs the number of emigrants again began to decrease, but after the liberation it attained the largest dimensions. From the time of their liberation the peasant population increased in a manner unprecedented in the present century; so that evident signs of an over population evinced themselves in many parishes and even districts of Russia, and emigration on a large

scale appeared as a natural necessity. Between 1860 and 1880 the emigration into the two western Siberian governments was estimated at 60,000 souls, and if the eastern governments and the Semirechinsk province be included, then the number during that period may be taken as about 110,000 souls. The emigration returns for recent years show that during the six years between 1879 and 1885 over 55,000 people passed into Siberia. Last year, 1892, after the famine in European Russia, about ninety thousand were registered at Tiumen. The emigration to the Altai mining district was particularly strong, and between 1884 and 1889 about 95,500 emigrants settled there.

Since 1861 the emigrants to the Amour and Littoral provinces are given special advantages, which with certain modifications are in force to the present day and consist in the following: Crown land to the amount of not over 100 dessiatines per family is allotted to each family or company under the condition of a free use of this land for the first twenty years, with the right of buying it, or after the lapse of these twenty years, of paying a rent fixed by the State. In those cases where the emigrant may desire to acquire more land than that allotted to a family, it can immediately do so by paying three roubles per dessiatine. And in general this is the price fixed for the purchase of land in the districts assigned by the Government for emigration, the pioneer being given the choice of his place of settlement. Being freed from the payment of taxes and State service for twenty years the settlers were freed from military service for ten years, and from the payment of rural taxes for three years. These advantages attracted settlers to the Amour and they gravitated through the whole of Siberia to Blagoveschensk and the valleys of the rivers Zei and Bourrei. In 1883 the Government started the peopling of the south Ussuri region, whither the peasants of European Russia were transported at the expense of the Government by steamer from Odessa through the Suez canal. The result of a three years trial was the settlement of over 4,500 souls in this region, at a cost of over a million roubles to the State. Emigrants to this region were also allowed to settle at their own expense, with the condition that each family should have a capital of not less than 600 roubles, beyond the travelling expenses, for starting farming in the new locality; and should they desire to enlarge their farms, they were given advances of 600 roubles per family for a period of 33 years.

In speaking of the colonization of Siberia it is necessary to mention also the sending of criminals into that region. It is generally thought that such transportation forms one of the modes of colonizing a country, but this is hardly the case. The distribution of the exiles in the different governments and regions is extremely uneven. In certain localities they are crowded to the extreme, for instance, in the Kainsk and Mariinsk districts of the government of Tomsk, they form almost one-sixth of the population, while in other districts and even provinces there are none, such as for example at Semipalatinsk, Kamchatka, the region of Okhotsk, and province of Akmolinsk. There are no accurate data respecting the increase of exiles through marriage, but judging from the reasons which hinder the multiplication of the exiles it may be concluded that this increase is very insignificant. The people transported for criminal offences are in the majority of cases single, hnsbands without their wives, wives without their husbands; and as, moreover, the number of males exiled into Siberia is ten times that of the females, the married couples made between the criminals must be compar-

atively small; besides this the indisposition of the vagabond exiles to a domestic life and of the natives to enter into marriage with the criminals and the predominance of prostitution, sickness, siphilis et cetera, among the exiled population, all this combines to prevent the multiplication of the exiled settlers and to paralyze it.

This historical sketch of the conquest and colonizaton of the vast area known under the general name of Siberia comes down almost to the present time. When during the second half of the present century it was discovered that the population was fast outgrowing its territory then colonization became one of the most important problems of the State. And thus it is that the Government has resolved to come to the aid of the national movement, and to regulate it by a series of measures. The matter was begun by the law of 1889, respecting the voluntary emigration of peasants and burghers to State lands where they previously had not the right of settlement. According to this law the Ministry of State Domains forms special allotments on the State lands for settlers and communicates concerning them to the Ministry of the Interior, who after investigating the local position of the families desirous of emigrating includes those which satisfy the necessary conditions in the emigration list and excludes those which are deemed unfitted. Emigration was also allowed to the south-western Siberian provinces peopled by the Kirghiz, and where Russians were not previously admitted, and in 1892 this permission was extended to the two governments of Eastern Siberia, those of Yenisseisk and Irkutsk.

The result of this emigration movement to Siberia was the settlement of Russian emigrants over the whole of the narrow southern band extending from the Urals over Western and Eastern Siberia proper and beyond the Baikal over the basin of the Amour to the Sea of Japan. And this is why, during the last ten years, the necessity of uniting all this extensive and in parts even, interrupted colonized area of Siberia by an uninterrupted railroad has become more and more evident both in Russia and Siberia. But the question of the construction of this line only came to the fore after the memorable journey of the Heir Apparent through the whole of Siberia. On his return to Russia from his long journey to the East, His Imperial Highness landed on Russian territory at Vladivostok, on the 11th of May, 1891, and read there the immemorial Imperial rescript of the 17th of March, 1891, published at St. Petersburg in the name of His Imperial Highness the Tsarevich and Grand Duke Nicolai Alexandrovich.

«Having now commanded the immediate construction of a railroad through the entire length of Siberia with the object of connecting these richly endowed provinces of Siberia with the internal network of railways, I commission you to announce such as my will on your return to the Russian territory after having visited the foreign lands of the East. At the same time I lay upon you the act of inaugurating the construction, at the expense of the Crown, of the Ussuri section of the Grand Siberian Railway at Vladivostok.

«May your auspicious participation in the inauguration of this truly national work which I have undertaken, serve as a fresh witness of my heartful desire to facilitate the relations between Siberia and the other portions of the Empire, and in such wise make known to this region, which is so dear to my heart, my liveliest care for its pacific progress».

This decided the question of the construction of the Great Siberian Railway which had occupied the attention of the Government and nation for over a third of a century; and this fact is one of the most important events of the present reign.

His Imperial Highness, the Tsarevich, in his voyage through the whole of Siberia from Vladivostok to the Urals, became personally acquainted with many of the immediate needs of this distant portion of the Empire and from that time the problem of the realization of this colossal work took a practical form. The construction was started simultaneously from the two opposite extremities of Siberia and as its completion necessitated numerous other subsidiary works having both the object of facilitating the actual construction and the peopling and industrial development of the districts adjoining the line, it was therefore decided at the end of 1892 to institute a special committee at St.-Petersburg under the title of the «Committee of the Siberian Railway» and to concentrate the entire direction of the matter in this Committee. His Imperial Highness the Tsarevich named by Imperial decree the President of this Committee, has already instituted a series of practical measures for the most rapid realization of this line connecting the Russian railway system with the Pacific coasts of Siberia.

CHAPTER II.

Geographical Review of Siberia.

It has already been shown that Siberia may be divided into five component parts each of which, in virtue not only of the vastness of its area, but also from the difference of its natural conditions, of the composition of its population and of its historical development, should be considered separately. The present review commences with those two portions which are known separately as Western and Eastern Siberia, and together as Siberia proper, in the limited sense of the word.

Western Siberia.

Its component parts: the Altai slopes and the western Siberian lowlands; geographical and orographical review of the Altai slopes; the western Siberian lowlands, their hydrography and division into three zones or bands; the cultivated agricultural, the forest and the polar-tundrys (frozen marshes); climatic conditions of those zones; the flora of the western Siberian valley and of the Altai slopes; the character of the fauna of Western Siberia; its population and its ethnographical composition and emigration; the distribution of domestic animals.

WESTERN Siberia, in the above sense of the term, is in its administrative aspect composed of the two governments, Tobolsk and Tomsk, and from a geographical point of view it occupies the greater portion, that is, 68 per cent, of the basin of the river Obi, or an area of 41,500 square geographical miles, that is, more than two-fifths of the area of the whole of European Russia and four times that of Germany.

With the exception of its north-western limits, where the low mountain chain of the Urals, from the sources of the river Kara to the northern extremity of the governments of Perm, form a boundary between Western Siberia on the one hand and the government of Vologda and Archangel on the other, and its entire south-eastern corner composed of the vast highlands of the Altai, the whole of Western Siberia presents a vast plain, very slightly elevated above the level of the Northern Ocean and plentifully watered by the numerous tributaries of the two immense branches of the vast system of the Obi, the rivers Irtysh and Obi.

The entire south-eastern corner of Western Siberia is occupied by the Altai highlands and lowlands forming the Altai Mining Region, the whole of which, to the extent of over

380,000 square versts, or 7,800 square geographical miles, forms a mountainous country eight times as large as Switzerland, and belonging not to the State but to His Imperial Majesty's Cabinet, that is, forming the private property of the Emperor. These lands passed into the hands of the Cabinet at the middle of the eighteenth century, from those of the Demidovs, the first occupiers and settlers, and the first to start a true mining industry in the country. One-third of the area of the Altai mining region is covered by the high mountain masses of the Altai. This is not a mountain chain but an immense highland, situated at the western extremity of the long chain of the Saian mountains which form the northern boundary of the internal highland of Asia and descends to the lowlands of Siberia. The Altai highlands are almost as broad as they are long and consist of a number of mountain ridges separated from each other by longitudinal and, in places, transversal valleys. The ridges extend in a not entirely parallel east to west direction, but slightly diverge towards the west after the fashion of a half-opened fan. Thus the Narimsk ridge which limits the longest of the Altai valleys, the Bukhtarminsk on the south, extends almost along the parallel, while the corresponding Kusnetsk Alatau, on the eastern extremity of the Altai highlands, has an almost meridional direction, while the rich in ores, but low Salairsk ridge extends to the north-east in a diagonal direction between the two above named ridges.

The high ranges of the Altai known under the name of «belki», which exactly corresponds to the word «Alps»,rise far beyond the snow line; they extend for a certain distance almost parallel, being divided from one another by the deep ravines of the mountain streams. The highest of all the ridges is that known under the name of the Katunsk Stolby. or Pillars of Katoun, which includes the picturesque Siberian Mont Blanc, the Beloukha, 11,500 feet high. Many other of the mountain ridges of the Altai rise beyond the line of eternal snow, such as the Sailughemsk, Chuisk, Aigulaksk, Kholsunsk and Turgussun belki. The height of these mountains in many cases exceeds nine thousand feet, while the snow line on the northern side of the Altai is not more than 7,000 feet, while on the southern aspect it is not under eight thousand feet. In its south-eastern portion the Altai evince an inclination to form tablelands, that is, more or less wide highland plains extending into the Alpine zone of the steppes, like the Chuisk and Kuraisk. The Altai belki chiefly consist of crystalline rocks, such as granites, cianites, diorites and porphyries and of metamorphic rocks, such as crystalline schists and also of grauvacke. The strata of the sedimentary rocks have been lifted by the crystalline and belong to the ancient paleozoic formations, such as the upper, silurian, devonian and carboniferous systems. Secondary formations like the jurassic are only met with in the most northern branches of the Altai. All the formerly rich deposits of argentiferous lead and copper ores, occur at the junction of the crystalline and sedimentary rocks Considerable glaciers descend from the Beloukha and feed the sources of the Katoun, one of the two component branches of the river Obi. The other of these branches, the Bea forms the outlet of the wonderful and vast Alpine lake Telets which in its beauty recalls the lake of the Four Cantons in Switzerland. Immediately over the lake rise the Telets belki, the highest of which, the Altyn-Tag, rises over 8,000 feet. At this point the steep declivities of the belki descend straight into the lake, which is fed by the mountain streams falling from the Sailughemsk ridge.

The Bea and the Katoun already unite at the foot of the Altai and form the majestic Obi. All the upper tributaries on the left of the Obi have their origin in the Altai highlands, for instance, the Anoui, Charysh and Alei, while those on the right hand proceed from the Kusnetsk Altai, for example, the Chumysh, Tom and Chulim. But the upper streams of the Irtysh, the other immense branch of the Obi, originate on the southern declivity of the Altai highlands within the frontier of the Chinese Empire. The reservoir collecting these upper streams is lake Zaissan which lies outside the limits of Western Siberia in the province of Semipalatinsk, while the right branch and large upper streams of the Irtysh below Zaissan, such as the Bukhtarma, Uba and Ulba, originate in the Siberian Altai belki and flow through their finest valleys. It is in these valleys, as well as over the whole of the north-western side of the Altai and of tablelands extending far into the Siberian valley, mainly the Salairsk and Kusnetsk Altai, that the mineral wealth of the country occurs. These minerals consist of argentiferous lead and copper ores, coloured stone from the so-called Korgonsk quarries, in the Korgonsk valley, and alluvial gold, while vast deposits of coal and iron ore occur in the so-called Kusnetsk coal basin between the Kusnetsk Alataou and Salairsk mountain ridges. Although the larger half of the Altai mining region, owing to its height above the level of the sea and the character of its soil, consisting as it does of rocks and rocky avalanches, is not habitable, still the remaining area which comprises not less than three thousand geographical square miles of the Altai lowlands is composed of fertile plains, hilly uplands and spacious valleys, and is extremely suitable for cultivation and colonization.

The remaining vast plain of Western Siberia which presents one of the most extensive lowlands in the world is covered with alluvial soil and in no portion of it do any denuded rock formations occur.

Only fresh water shells of the upper tertiary formation have been found in the friable strata which forms the under-soil. These strata consist of sand and clay and are chiefly exposed along the declivities of the right and always slightly elevated banks of the rivers. No point of these lowlands apparently rises over 400 feet above the sea level. Nevertheless the western Siberian lowland is plentifully watered by the two high rivers Obi and Irtysh and their numerous tributaries which flow together to the far north. The Obi-Irtysh river system comprises one of the most colossal basins of the earth and can compete with the river regions of the Yellow and Blue rivers and the Nile of the Old world, or the Amazon and the Mississippi of the New, besides the neighbouring river systems of Siberia. The area of the river basin of the Obi within Western Siberia and the Chinese Empire is over 60,000 geographical square miles and the length of the river course, counting its source as either the Obi and Katoun or the Irtysh, Zaissan and Kara Irtysh, gives almost one and the same figure of 4,900 versts. Moreover the navigable network of the river includes the whole of the Obi from its mouth to the junction of the Bea with the Katoun and the Irtysh from its mouth to its rapids through the mountain gorge, above Ust-Kamenogorsk and the tributaries of the two chief branches of the system, the Tura, Tavda, Chulym and Tom to their lower courses. Unfortunately the colossal water way of Western Siberia has the great disadvantage, that it is locked by the ice of the gulf of Obi for the greater part of the year and is almost inaccessible to the sea

for this reason and also that the two chief rivers intersect the main line of the Siberian trade traffic at right angles. Although fortunately the junction of the two branches of the Obi forms an uninterrupted and excellent navigable route between the most important and almost extreme points of this line of traffic in Western Siberia, the cities of Tiumen and Tomsk, this route is too circuitous and for the greater part lies outside the cultivated and agricultural regions of Siberia.

Western Siberia abounds in lakes. Besides the picturesque mountain lakes in the narrow valleys and circular basins of the Altai, a very large quantity are situated in the Western Siberian lowlands, and especially in its southern limits, in the Ishimsk, Barabinsk and Kouloudinsk steppes. Among the lakes there are some of vast dimensions, such as lake Chan which covers over 60 geographical square miles. There are also numberless small lakes which have no outlets, although some are fresh water, as well as salt lakes.

In order to explain better the character of the vast Western Siberian lowlands and their capacity for settlements and cultivation, it is necessary to subdivide it into three zones presenting quite different types. The first of these types is the cultivated agricultural zone of Western Siberia. It is composed of all the districts of the government of Tobolsk, except the two northern, that is, the Berezovsk and Sourgoutsk districts, and also of the lesser northern portions of the Tarsk district and the greater northern portions of the Tourinsk and Tobolsk districts, of the government of Tobolsk and of all the lowland portions of the government of Tomsk which do not enter into the composition of the Altai mining district, with the exception, however, of the so-called Narymsk region which occupies four-fifths of the area of the Tomsk district. Under these conditions the cultivated agricultural zone of the Western Siberian plain occupies an area of 8,500 geographical square miles, and is characterized by the fact that it is capable of an agricultural and settled colonization, and at the same time is throughout plentiful in forest. Naturally in this zone there are also large areas which are unfitted for cultivation and a settled population. The most important example of such a locality are the so-called Barabinsk steppes, where the stagnant water of the fresh water lakes alternates with salt lakes and marshes, and the vast Vasugansk bog which occurs on the boundary of the cultivated agricultural zone. But it may be estimated that six thousand geographical square miles of this zone are suitable for colonization and agriculture. The second type is represented by the Western Siberian zone of high-stemmed forests, which comprise the great northern portions of the Tourinsk and Tobolsk districts, the northern portions of the Tarsk and the southern portions of the Sourgoutsk and Berezovsk districts of the government of Tobolsk, and the whole of the vast regions of Narym in the government of Tomsk. This zone occupies an area greater than that of the Altai mining region and the cultivated agricultural zone taken together, namely, eighteen thousand geographical square miles, and it is characterized by the fact that it consists, like the greater part of the government of Archangel and the north-eastern portions of the government of Vologda in European Russia, of a continuous mass of forests and bogs, in which there are only isles or oases in any way suitable for settlement, scattered chiefly on the firm banks of the rivers. And lastly the third type comprises the portions of the Beresovsk and Sourgoutsk districts lying beyond the parallel of Beresov, that is, 64° north latitude, and forming the polar marsh land zone which extends over seven thousand geographical square miles of Western

Siberia. In this portion the forests become thinner and smaller and change into low bushes. The boggy marsh land covered with mosses and lichens is frozen for the greater part of the year and is totally unfitted for an agricultural settled habitation. The under-soil of the marshes never thaws below a depth of one and a half arshines and consists of intermittent strata of frozen earth and clay and of pure ice, which thus forms, as it were, the rock formation of the district.

The climatic conditions of each of these three zones are naturally very different, and in them is also found the explanation of the difference in the comparative fitness of each for cultivation and colonization. In general, compared with the climate of the corresponding latitudes of European Russia, the climate of Western Siberia is distinguished by its great continentality, which is seen in the lower average yearly temperature compared with the localities lying under one and the same degree of latitude in European Russia, in the greater severity of the winters and consequently in the greater difference between the average temperature of summer and winter, and between the coldest and warmest months, and lastly in the somewhat smaller rainfall and snowfall.

Thus in the cultivated agricultural zone of Western Siberia, the average yearly temperature is nearly zero, or for the average, taken at eight points of observation $+0{\cdot}33^{\circ}$, while that of the same latitudes in European Russia does not exceed 3° Celsius. The average winter temperature of the cultivated agricultural zone of Western Siberia is -17°, and during the coldest months -18°, while in the corresponding parts of European Russia it is -11.5° and during the coldest month -12.5° Celsius. On the other hand the average summer temperature of $+17.5^{\circ}$ and that of the warmest month $+19.5^{\circ}$ even exceed, although not more than half a degree, the similar temperatures in the corresponding latitudes of European Russia. Thus the difference of the average summer and winter temperatures in the agricultural zone of Western Siberia is 35°, while in the corresponding parts of European Russia it is 28°. The difference of the average temperatures of the coldest and warmest months in Western Siberia is 39°, and in the corresponding parts of European Russia 32°; but there is an entire similarity between the average temperatures of the cultivated agricultural zone of Western Siberia and the corresponding parts of European Russia during the five months of vegetation, that is, from the first of May to the first of October, new style, when the average temperature of one and the other is $+15^{\circ}$. Hence this region of Western Siberia is not less suitable for a settled agricultural life than European Russia between 55° and 58° of the northern latitude, and indeed it is better fitted, because the soil of Western Siberia is fresher than that of European Russia, the pasturage richer and vaster, the rivers more abundant in water and there is no want of forests.

The climatic conditions of the more southern lowland and of the excellently sheltered from the north, although more elevated, valleys of the Altai are still better. But naturally these conditions in the Altai mining region become less favourable as the elevation increases. Thus at Barnaoul at an absolute elevation of 460 feet the average temperature during the five months of vegetation is $+15^{\circ}$, which is most favourable for the development of agriculture, while at Salair at an absolute height of 1,180 feet this temperature scarcely exceeds $+13^{\circ}$ Celsius, which is not suitable for the ripening of the more tender kinds of grain.

The more continental character of the cultivated agricultural zone of Western Siberia, as compared with the corresponding latitudes of European Russia, is also observable in the amount of rain and snow. In the region under consideration the annual rain and snowfall is 380 millimetres, while in the corresponding parts of European Russia it is as much as 500. A still greater difference is seen in the winter fall, which in the Siberian zone is only 50 millimetres while in the corresponding portions of European Russia it is over 80. In summer the difference is not so great, namely, the fall in the Western Siberian zone is 175 millimetres and in the corresponding parts of European Russia, 185. Hence in the agricultural zone of Siberia the winters are in general far poorer in snow than in European Russia, so that in the southern limits of the agricultural zone the cattle scratch away the snow with their hoofs and find fodder under their feet in winter, only the winds (bouran) which rise at a temperature of not under — 10° Celsius, and meeting with no impediment in the vast plain, sweep away the snow into huge drifts and snow ridges.

The Altai lowlands differ but little from the cultivated agricultural zone in respect to the rain and snow fall, only the quantity is far greater on the very slopes of the north and north-west Altai, and especially in the valleys. Thus at the station of the Altai clergy Ulal, the yearly fall is 600 millimetres, half of which fall is during the three summer months. This explains the luxurious vegetation of the Altai. The dews, for instance, in the Ulbinsk and Oubinsk valley are so powerful that when riding in clear sunny weather along the narrow pathway the rider becomes quite wet, as his horse breaks through the tall grass. But on the other hand, on the southern Altai, the slopes of the wide valleys facing the south are so dry that they are quite void of forest vegetation and only exhibit the high steppe plants of Central Asia. The so-called forest and forestry zone of Western Siberia presents quite other climatic conditions, industries and sporadic agriculture. Here the average annual temperature is as low as — 2°, while in the corresponding zone of European Russia it exceeds + 1°; the winter temperature is — 20°, and that of the coldest month, — 22°, while in the corresponding parts of European Russia, the mean winter temperature is — 14°, and that of the coldest month — 16°. Even the average summer temperature, + 14°, is lower than that of the corresponding localities of European Russia, + 16°; and only the temperature of the hottest month (18°), surpasses that in European Russia (17°). Thus, the difference, too, between the mean temperatures of winter and summer, (34°), and in particular, between the coldest and hottest months, (40°), is more considerable than the difference for the corresponding parts of European Russia, the first being there 30° and the second 33° Celsius. As far, however, as concerns the temperature of the vegetative period, especially important for agriculture, it falls in the zone under consideration to 12° and lower, and is even more unfavourable than in the corresponding parts of European Russia, where it for the most part certainly, stands higher than 12°, and here and there even, than 13°, as in St. Petersburg, Bielozersk, Vologda, Ustiug, Slobodskaia and Cherdyn. Everywhere where the temperature of the vegetative period does not exceed on an average 12° Celsius, agriculture reaches, so to say, its limit, and shows itself only in a sporadic form, scanty cultivated oases being lost in vast areas, covered with forest and morass and unsuited to tillage. As far, however, as concerns rainfall, its amount is very much more considerable in the forest zone of Western Siberia than in the agricultural zone, forming 470 millimetres a year, which differs

very little from the rainfall occurring in the course of the year in the corresponding parts of European Russia, 480 millimetres. Only a larger proportion than in European Russia falls in the summer months, namely 220 millimetres, the average for European Russia being 190.

Finally, very various are the climatic conditions presented by the polar tundra zone, of which unfortunately we are in a position to judge almost exclusively from the observations taken on the southern border of the zone at Beriozov. Judging from these observations the mean annual temperature falls here as low as — 5°, and even lower, the soil at a depth of three-quarters to one arshine being perpetually frozen. The winter temperature is lower than — 21°, that of the coldest month, below — 23°, while the summer temperature does not exceed + 13°. 5, and that of the hottest month, + 18°, forming a difference between summer and winter of 34°, and between the hottest and coldest months, of 49° Celsius. In Beriozov the mean temperature of the five-month vegetative period scarcely exceeds 9°, and it is therefore intelligible that the rivers are here ice bound forty days longer than on the frontier of the forest and agricultural zones, that the cereals are quite incapable of growing and that the forests attain the extreme range of their existence. Domestic animals also reach their limit in the polar tundra zone, with the exception of the reindeer, which is peculiar to the tundras of this zone. To the north of Beriozov, beyond the arctic circle, the rainfall also decreases; in Obdorsk the annual amount is only 218 millimetres, while in Beriozov it is as much as 467 millimetres.

The climatic conditions of a country appear most clearly and directly expressed in its vegetable covering. It follows from the above explained climatic conditions that the herbaceous vegetation of the Western Siberia lowland differs very little from the flora of the corresponding zones of European Russia, the more so that the comparatively low range of the Ural is no barrier to the dissemination of plants whose seeds are freely borne hither and thither by the wind over the vast plains adjacent to either side of the mountain range and lighting upon analogous conditions are sown and reproduce their kind without let or hindrance. The traveller entering Siberia through Ekaterinburg or Zlatoust, crossing the whole Siberian plain as far as Tomsk and further to the Yenissei, is not struck with any difference in the herbaceous vegetation, but very few western species disappear, at times changing to eastern varieties, as for example, the pale yellow heads of the European crow's-foot (trollius europeus L.) are replaced by the fiery orange of its Asiatic variety (trollius asiaticus L.). Only very few oriental forms appear not occurring in European Russia, or only here and there crossing its frontier, as for example, some anemones (anemone reflexa Steph., altaica Fisch. and pennsylvanica L), one beautiful species of paeony (paeonia anomala L), a few cruciferae (dentaria tenuifolia Led, chorispora sibirica, D.C., hesperis aprica poir), one species of violet (violla uniflora), among the caryophyllaceae, lychnis sibirica L, among the compositae, a few species of wormwood (artemisia desertorum Spr., turczanoviana Bess; macrantha Led latifolia Led), the eastern forms of gentians (gentiana auriculata, Pall., aquatica L, halenia sibirica Borkh), et cetera. But the general character of the herbaceous flora remains, the same, the plants merely becoming somewhat more sappy and fresh, and the flowers brighter coloured than in European Russia. It is different with the trees upon which not the mean temperature of the vegetative period alone, almost constant on that side of the Ural, exerts

an influence, but the comparative severity of the winters and their relative dryness. Of the trees spread over all European Russia, there disappear, immediately on crossing the Ural: the oak, two species, (quercus sessiliflora, Im. and quercus pedunculata Ehr.), the hazel (corylus avellana L.), the two elms (ulmus campestris L. and ulmus pedunculata Fouq.), all species of maple (acer), the ash (fraxinus excelsior L), and finally, the apple tree (pyrus malus L). The woods of the agricultural and forest regions of Siberia are composed of the conifers: the Siberian fir (abies sibirica Led.), passing from Siberia into north-eastern Russia, and in Siberia itself reaching to Kamchatka, the oriental or Siberian pitch-pine (picea orientalis L.), also passing into the northern and north-eastern part of European Russia, and through Siberia reaching the Kuril islands; two species of larch, the Siberian (larix sibirica Led.), also passing into the north-eastern part of European Russia and in Siberia spread as far as Baikal, and the dahur larch (larix dahurica Trautv.) a purely Siberian form, occurring in Western Siberia between Beriozov and Obdorsk; the Siberian cedar (pinus cembra L.), scarcely crossing the Ural on the European side, but in Siberia spread as far as Behring Sea and crossing into the northern part of America; finally, the common pine (pinus communis L.). The Sibèrian taigas and urmans are formed of these species. With the conifers in these taigas are associated certain foliage trees, in particular the aspen, and to some extent, the birch on the skirts of the taiga. In the cultivated or agricultural zone, with soils similar to Chernoziom of European Russia, foliage trees prevail, and even over such areas as are called steppes by the Siberians; for example, on the Baraba steppe, groves of trees alternate pleasantly with prairie, and in localities occupied by a permanent colonization with field and fallow. The foliage forests of the Western Siberian plain consist of the following species: the common birch (betula alba L.), aspen (populus tremula L.), the abele (populus alba L.) occurring only in the southern part of the plain; both species of alder (almus glutinosa W. and almus incana W), linden (tilia parvifolia Ehrh), the last also confined to the southern part of the cultivated zone. To these lofty kinds must be added two kinds of rowan, the ordinary mountain ash (sorbus aucuparia L.) and the Siberian species (sorbus tomentosa L.); the common bird cherry (prunus padus L.) and also many sorts of willow (salix) of which more than fifteen European Russian species occur in the forest and agricultural zones of Siberia.

There are very few shrubs thriving in the Western Siberian plain which are not found in the wild state in European Russia. Among such must however be reckoned the common garden acacia (caragana arborescens Lam.), the red hawthorn (crataegus sanguinea Pall) the cornel (cornus alba L.), so well acclimatized in the gardens of European Russia, and one kind of meadow sweet (spiraea fruticosa L).

The flora of the polar tundra zone presents very little difference from that of the European Russia tundras of Lapland and Samoyed. Nearly all this zone's characteristic low-growing, stunted shrubs, for example one species of arbutus, (arctostaphilus alpina Ad.) the heathers or andromedas (cassiope tetragona Don., C. hypnoides Don.), phylodoce saxifolia Salisb., loiseleuria procumbens Don., a species of ledum—latifolium Ait., also belonging to the European flora, and only one species of the polar azalea (osmothamaus fragrans D. C.) and one polar willow (salix arctica L.) are not met within European Russia.

The mountain flora of the Altai uplands on the other hand is in quite a different condition. Here, beginning already at a height of three thousand feet, the vegetation is extremely peculiar and gradually passes into the alpine flora, proper to the Asiatic Alps. Of course this flora contains not a few plants which belong to the arctic zone of the Old World, which also climb the European Alps, but an enormous proportion of the plants are the typical and peculiar property of the alpine and subalpine zones of the Altai Saian mountainous region, when only a few species cross the ranges of Central Asia, such as the Tian-Shan and the connected Semirechinsk and Zailisk Altai. Among the shrubs characteristic of the subalpine zone of the Altai may be noticed: a few species of acacia (caragano microphylla Zam., bungei Led., pygmaea D. C., spinosa D. C., tragacanthoides Poir), two dog roses (rosa platyacantha Schr. and Gebleriana Schr.), the galten tree (cotoneaster uniflora Bge), some species of currant (ribes aciculare Sm., saxatile Pall, cuneatum Kar., heterotrichum Moq., procumbens Pall), two species of tamarisk (tamariscenae), myricaria alopecuroides Sch. and daurica Ehr.), three honeysuckles (lonicera humilis Kar., hispida L. and bungeana Led.), one species of azalea (osmothamnus pallidus D.C.) and two rhododendra (rhododendron chrysanthum Pall. and davuricum L.); among acicular leaved shrubs, ephedra stenosperma Schr., and intermedia Schr., juniperus pseudosabina Fiseh. and davurica Pall., and two kinds of birch, betula microphylla Bge, and betula tortuosa Led.

Much more characteristic is the herbaceous vegetation of the alpine and subalpine meadows and slopes, which enchant the eye with the richness and brilliancy of their flowers. The following may be indicated as among the species most characteristic for the Altai Sayan mountainous system, a few beautiful anemones (anemone umbrosa Mey., Fischeriana D. C. and pulsatilla bungeana Mey.), peculiar kinds of crow's-foot (ranunculus altaicus Laxm., longicaulis, pulchellus, natans, lasiocarpus, propinquus, grandifolius Mey., and the exceptionally interesting oxygraphis glacialis Bge. and callianhemum rutaefolium Mey), a ranunculus with pale lilac flowers (hegemone lilacina Bge.) larkspurs (delphinium laxiflorum and dictyocarpum D. C.), three fumitories (corydalis nobilis Pers., stricta Pers. and inconpticua Bge.), as many as thirty altaic species of crucifers, belonging to the high alpine zone (of the genera mathiola, arabis, parrya, macropodium, psilotrichum, draba, holargidium, chorispora, dontostemon, braya, eutrema, Hutchinsia) charming species of violets (viola altaica Pall., macrocarpa Bge., imberbis Led. and acuminata Led.), fifteen or so peculiar species of caryophylleae and stellariae, altaie varieties of flata (linum violaceum Bge), St. John's worts (hypericum gebleri Bge), some forty beautiful variegated sort of leguminosae, among which especially prominent are numerous species of astragalus (astragalus and oxytropis), whose extensive family climbs from the Central Asiatic steppes to the eternal snows of the Asiatic mountain ranges. Next follow the quaint, high alpine forms of rosaceae (sibbaldia adpressa Bge., dryadanthe bungeana Led., chamaerodon altaica Bge., potentilla altaica Bge., comarum salessowi Bge.). Further there are a few characteristic saxifrages, among which in particular the so-called Chagyr tea (saxifraga crassifolia L.), the large leaves of which serve as a surrogate to tea. There are some twenty species of Altai compositae, among them several species of saussure (pygmea Spr., pycnocephala Led., latifolia Led., acuminata Turcz., foliosa Led.) Finally the primalaceae largely contribute to the adorn-

ment of the alpine meadows of the Altai (primula longiscapa Led.), charming blue and yellow gentians (gentiana atrata Bge., azurea Bge., tenuis Bge, altaica Pall, karelini Fries., frigida Haenk., macrophylla Pall.), irises, (iris glaucescens Bge., bloudowi Led. and tigridia Bge.) and some bulbous plants: tulipa altaica Pall., lilium tennifolium Fisch. and L. spectabile Link, fritillaria verticillata W. et cetera.

The extraordinary wealth and variety of the Altai flora finds its explanation not only in the circumstance that in the Altai, as in every mountainous country, within a comparitively narrow compass, various climates are superimposed one upon another, but also in this that the extremely varied contour of the Altai mountain region presents very distinct ridges, cut off by deep longitudinal valleys and intersected by short transverse valleys, and at the same time extensive elevated plateaux and low hummocky foot hills. Over the whole of this vast mountainous area situated between the limitless and relatively moist plain of Western Siberia sloping to the Arctic Ocean, and the almost equally unlimited parched steppes of Central Asia, a struggle is constantly going on between the north and north-west damp aerial currents and the southern and perfectly dry winds in the lower layers of the atmosphere. In consequence of this, polar forms, or an isolated high alpine vegetation, prevail upon the northern slopes of the Altai, while its southern slopes are climbed by the flora of the Central Asian steppes, which chancing as it rises upon more favourable climatic conditions, becomes differentiated into a whole series of original high steppe varieties. To such forms belong, for example, the peculiar species of astragalus and oxytropis of the Altaic meadows of the alpine zone.

A like dependence upon climatic conditions is also shown by the higher invertebrates, namely, the insects, and especially such of them as for example, the majority of the coleoptera, not possessing any considerable capacity for flight, have not any extended regions of distribution and are accordingly dependent to a greater extent upon local conditions of climate, soil and vegetation. But here, as in the case of the flora, the insect fauna of the Western Siberian plain differs little from that of European Russia and only the fauna of the Altai mountain region is as richly varied and original as the flora. The local forms of coleoptera incapable of flight, are peculiarly eccentric; for example, species of carabus, some of which are exceedingly rare: car. imperialis Fisch., car. regalis Boeb., car. Gebleri Fisch., car. Leachi Fisch; car. Loschnikowii Fisch, et cetera, and wingless wood cutters (for example, dorcadion politum Dalm.) et cetera. The vertebrates have a wider area of distribution. Those which are hunted maintain themselves best in the vast uninhabited regions of Eastern Siberia, and will accordingly be dealt with when that country comes to be described.

The question of the distribution and classification of the native and Russian population of Western Siberia will now be considered.

The total population of Western Siberia amounts to 2,700,000 of both sexes, of whom only eight per cent are natives, the immigrant Russian element forming ninety-two per cent. Among the native population the first place in point of numbers is occupied by Finno-turkish tribes, known under the collective name of Tartars. They are a remnant of the tribes which composed the ancient Kuchum Siberian Kingdom. There are now calculated to be ninety thousand of these Tartars in Western Siberia. They are distributed in such a way that as

many as 20 thousand dwell in the Altai mining district. Half are settled, accepted long ago the orthodox faith and are strongly russified; the other half nomadizes, or more accurately, leads a vagabond life and holds to shamanism. In the cultivated or agricultural zone are 50,000 Tartars; part of them have become russified, but the majority profess mohammedanism, and to a certain extent, as for example, in the Baraba steppe, lead a nomad life. Finally, in the zone of forest industries and sporadic agriculture there are yet another 20,000 Tartars, partly with fixed habitations, partly wandering, and mainly professing the mohammedan religion. The Tartars speak for the most part a Tiurksk dialect, resembling that of the Kazan Tartars in European Russia, but among some of the Tartar tribes of the Altai mining district Finnish dialects are still preserved.

Another native element consists of the purely Finnish tribes of the Voguls and Ostiaks. The number of both together amounts to 40,000 souls. The majority of these tribes, namely 30,000, inhabit the forest zone of Western Siberia and belong to the hunting peoples. Only the southern members have accepted orthodoxy and become russianized; the majority adheres to shamanism. As many as 10,000 Ostiaks dwell in the polar tundra zone, where they occupy themselves with reindeer breeding and fishing, and have become largely assimilated with the Samoyeds.

The third native element is the polar tribe of the Samoyeds. They are reckoned to number 20,000 souls, of whom the majority still inhabit the forest zone; the minority, the polar tundra zone, where they are engaged in rearing reindeer and in fishing.

Finally the fourth native element is formed by the Mongol tribe of Kalmycks, inhabiting the Altai mining region to the number of 20,000. The russification of the natives only proceeds in the cultivated zone and in the Altai foot hills. In the forest region, and still more in the polar tundra region and in the internal valleys of the Altai, the natives preserve their national traits. On the whole there is no evidence of the extinction of the natives in Western Siberia.

The most considerable part of the population of Western Siberia is composed of Russian emigrants, who are very unevenly distributed over the different zones or regions of Western Siberia. In the cultivated zone of Western Siberia dwell 1,800,000 persons of both sexes, that is, 212 inhabitants to the square geographical mile, out of whom less than three per cent belong to the native non-Russian population. Considerable also is the population of the Altai mining district, amounting to 600,000 souls of both sexes, or 78 per square geographical mile, of whom the native tribes form not more than seven per cent. The population scattered in small oases among an unbroken stretch of forests and swamps, namely that of the zone of high growing trees, forest industries and sporadic agriculture, is much thinner. Its extent does not exceed 270,000, or 15 inhabitants to the square geographical mile, among whom the native tribes form 15 per cent. Finally in the polar tundra zone the population does not exceed 30,000 of both sexes, the natives here, however, constituting more than 95 per cent, which clearly demonstrates that the Russian settled population cannot live in this zone, the Russians here appearing not as settlers but only as proprietors and exploiters of the country.

It is evident that in Western Siberia the relation borne by the town inhabitants to the total population is even lower than in European Russia, where in its turn, the proportion of

the town population is low enough compared with the same proportion in Western Europe and America. In European Russia the proportion of the inhabitants of the towns to the total population is 13 per cent, in Western Siberia, less than eight per cent.

Of the towns of any importance in Western Siberia possessing at the same time a really urban character, there are only seven: Tomsk, with a population of about 40,000; Tobolsk, with 20,000 inhabitants; Barnaoul and Biisk each with 17,000; Tiumen, with 14,000; Mariinsk and Kolyvan, each with 13,000 inhabitants.

In immediate connection with the density, distribution and manner of life of the population is the distribution and apportionment of the domestic animals, of which the nearest to man, at any rate in country life, is the horse, serving as it does not only for field work but for travelling from place to place and for the conveyance of goods. The population of Western Siberia, occupying as it does a vast and thinly inhabited territory, upon which agriculture, working a virgin soil without steam motors, leaving extensive wastes covered with a luxuriant herbaceous vegetation, has a particular need for the horse and is in a position to feed it from the abundance of fodder. Therefore, while in the thickly populated and most highly industrial countries of Europe like, for example, Belgium and Great Britain, the proportion of horses per 100 inhabitants hardly exceeds the figure five; in the more agricultural countries of France and Germany, does not surpass eight; in those still very rich in natural meadows and pastures, such as Hungary and Denmark, it reaches twelve and seventeen, and in European Russia and the United States of America, twenty-two; in Western Siberia the number of horses per 100 inhabitants reaches sixty-three, the absolute number being 1,700,000, in other words, to each man of working age there are two to three horses.

Under such circumstances, as might be inferred, the number of the other domestic animals is also proportionately very high. To every 100 inhabitants in Western Siberia there are fifty-two head of horned cattle, the absolute number being 1,400,000, that is, from two to three head per married couple. Finally there are eighty-five sheep and goats per 100 inhabitants, the absolute number being 2,300,000. The northern reindeer is the domestic animal of the polar tribes, inhabiting the polar tundra zone which might in Western Siberia be called the region of reindeer breeding. The absolute number of these animals in Western Siberia extends to 240,000 head. As the population employed in rearing reindeer in the polar tundra zone and in the northern part of the forest zone, Samoyeds and a portion of the Ostiaks, does not exceed 40,000, it follows that there are 600 reindeer to every 100 inhabitants; and as long as such a proportion per man of domestic animals in the far north can be maintained, so long the polar tribes of Western Siberia will not exhibit any tendency to become extinguished.

CHAPTER III.

Eastern Original Siberia.

Its Sayan borderland; the hydrography of Eastern Siberia and its division into three zones or tracts, the cultivated or agricultural, mingling with the Sayan foothills; the zone of high stemmed trees and forest industries, and the polar tundra; the climatic conditions of each of these zones: the vegetative covering of Eastern Siberia and its fauna; mammalia of the polar and forest zones; the population of Eastern Siberia, its ethnographical composition and disposition; the distribution of the domestic animals.

EASTERN Siberia in the narrow sense, that is, the eastern half of the original part of Siberia inhabited principally by a Russian population, in administrative relation is made up of two governments, those of Yenisseisk and Irkutsk, and in geographical respects occupies the greater part of the basin of the twin river Yenissei-Angara, and farther embraces the riverine regions of the polar streams, Piassina, Taimyr, and Khatanga, the small upper part of the basin of the river Lena and parts of the frontier basins of the rivers Taz on the north-west, and Anabera on the north-east. Even thus limited, Eastern Siberia covers an immense area of sixty-two thousand square geographical miles, exceeding twice the extent of Germany, Austria and France taken together.

The southern borderland of Eastern Siberia is formed by the northern chain of the long and lofty Sayan range, which for a considerable part of its extent bears the name of Erghik-Targak-Taiga and serves as the frontier between Russian territory and the Chinese possessions. This chain follows roughly a direction from west to east, but departs from the parallel by a wide bend to the north. South of this chain, between it and one further to the south bearing the name of Tannu-Ola and connected at both its extremities with the Sayan by mountain spurs, spreads a very wide valley shut in on all sides by mountains known in the most ancient times by the name of Erghené-Kon or Irgana-Kon, and celebrated in history for having according to tradition served as the cradle of the Tiurk tribe, which it is said expanded itself from this point over all Asia. In this valley mingle the two great constituent branches of the Yenissei, flowing from the southern slope of the Sayan, the rivers Ulukem and Beikem. After its confluence with three tributaries, the river Kem so reinforced receives the Kemchik on the left or western side of the valley, and taking the name of Yenissei, bursts through the narrow defile of the Sayan and comes out on the Sayan slope of Eastern Siberia. Within the limits of the Yenisseisk, and in the western part of the Irkutsk government the Sayan range proceeds without subdivision, merely sending off a few spurs penetrating deeply into the southern part of the Yenisseisk government on the north.

Somewhat more complex is the construction of the Sayan in the south-eastern portion of the Irkutsk government, beginning with its most elevated mass situated between the head waters of the Beikem and Ulukem, on the one hand, and those of the left tributaries of the Angara, Oka, Belaia and Irkut, on the other. Here this range shows a tendency to break up into chains, or ridges, parallel to each other and separated by longitudinal valleys, here united by projections of the main crest, there cut asunder by transverse dales through which the numerous rivers struggle out the slope of Eastern Siberia and form the left tributaries of the Angara.

In the midst of the main crest of the Sayan, at the south-eastern corner of the Irkutsk government, the highest mountain mass of the Sayan range lifts itself far above the limits of eternal snow in its highest point, the Munku-Sardyk peak, lying on the Chinese frontier, reaching an elevation of 11,430 feet above the sea level. This mountain, as also some other summits in its neighbourhood situated on the projections of the Sayan range crossing into Russian territory and called here not belki as in the Altai, but «golets», feeds more or less considerable glaciers and ice fields, occurring on a somewhat greater scale in this part of the Sayan than in the Katun Pillars of the Altai. A little lower than those golets rise, parallel to the main crest of the Sayan, the forward ridges, among which the most remarkable is the Tunka range lying close to Irkutsk. In another of these ridges, at a distance of 120 versts to the south-west of Irkutsk, is the mountain Khamar-Daban, reaching an elevation of 8,940 feet above the sea level. In connection with this Khamar-Daban are two ridges stretching almost parallel to each other in a north-easterly direction. In the wide and very long valley separating them, is situated one of the largest lakes on the world's surface, Baikal, whose area of 640 square geographical miles is equal to the extent of the Kingdom of Holland with the Grand Duchy of Luxemburg; its breadth exceeds the length of Lake Geneva, and its length is 670 versts. Lake Baikal is fed mainly by rivers flowing over the Transbaikal region, the Upper Angara, Barguzin and Selenga. Its outlet is the colossal right branch of the vast river system of Eastern Siberia, the Angara, bursting first through the defile of the Baikal range, confining the lake on the north-west, and afterwards intersecting the extremities of several of the spurs of the Sayan extending far over its slope. It is at these points of intersection that the Angara forms its celebrated rapids.

All the chief summits of the Sayan range, and even of its offspurs, consist of crystalline rocks, granites, sienites, more seldom diorites, porphyries and diabases, and also of gneiss and crystalline schists. In the eastern part of the Sayan range, and also in the low ridges intersecting the Eastern Siberian plain between the Angara and the Podkamennaia Tunguzka, real plutonic rocks are met with, such as bazalts, dolerites and even lavas, from the long since extinct volcanoes, with vulcanic tufas, obsidian and pumice. The sedimentary rocks upon the slopes of the Sayan ridges consist of sandstones, schists and limestone belonging to the paleozoic formations, silurian, devonian and carboniferous, but further to the north in the denuded parts of the low ridges, intersecting the Eastern Siberia plain, secondary formations also are met with, such as triassic and jurassic.

The mineral resources of Eastern Siberia are considerable. Upon the northern acclivity or the Sayan in the Yenisseisk government, mines of argentiferous lead and copper are found, and

in the region of the foot hills are scattered here and there seams of coal and iron ores. Deposits of excellent graphite are found upon one of the offsets of the Sayan range, and lapis lazuli has been discovered along the river Sliudianka, also in that region. Eastern Siberia, however, is richest of all in gold bearing sands, situated not only on the slope of the Kuznetski Altai and upon the spurs of the Sayan range, but to a yet greater degree upon the extensive area between the Angara and the Podkamennaia Tunguzka.

Eastern Siberia is watered as abundantly as Western. The great river Yenissei, consisting like the Obi of two almost equal branches, the Yenissei proper and the Angara, has a length of 3,800 versts, if the Ulukem be reckoned as its beginning; and of 4,800 versts, if its head waters be taken as the Upper Angara or the Selenga. The vast watershed of this river covers an area of 54,000 square geographical miles.

As a water way, the Yenissei has the same inconveniences as the Obi; it intersects the great Siberian tract at right angles, flows northwards, almost without swerving, and falls into the inhospitable Kara Sea, ice-bound the greater part of the year. However, the experience of the last twenty years has shown that the mouth of the Yenissei is more accessible to communication by sea, than that of the Obi, and that for the most part ships penetrating in late autumn into the Kara Sea through the narrow straits dividing the two islands of Nova Zembla, the so-called Matochkin Shar, or through the Kara Gates, cannot only reach the Yenissei bay without encountering any obstacle, but having unloaded and reloaded at the wharf, constructed near the entrance to the frith previously to the closing of the navigation, may return to Europe.

The Angara and Yenissei mingle their waters precisely as do the Obi and Irtysch, but the curve formed by them is not thrust so far to the north, passes through localities less desert in their character, and with the existing hydrographic communication between the Obi and Yenissei by means of the Ket and Koss, the Angara might serve as an excellent water way to Baikal and Transbaikalia, were it not intersected by a whole series of cataracts and falls, which are however now being gradually cleared away. Besides the Angara both the tributaries of the Yenissei falling into that river below the Angara, the Podkamennaia and Lower Tunguzka, are navigable, flowing however through regions almost absolutely deserted.

The great expanse of Eastern Siberia may be subdivided into three tracts or zones differing very much from each other. The first and most southern of them is that which is called the cultivated or agricultural, but which properly corresponds to the two regions of Western Siberia characterized above, namely, the Altai mining and low-lying agricultural, as the foothills of the Sayan range and its offshoots occupy the whole cultivated zone of Eastern Siberia, and as it is impossible to draw a definite boundary between the agricultural and the mining zones of Sayan. The cultivated agricultural zone is composed accordingly of the four southern districts of the Yenissei government, namely, Minussinsk, Achinsk, Krasnoyarsk and Kansk, and all the districts of the government of Irkutsk, but Kerensk. This zone of Eastern Siberia so defined, includes an area of 10,500 square geographical miles, but as the greater half of this area, partly on account of its high absolute altitude, partly on account of its mountainous and rocky condition, stony or swampy soil, is entirely unsuited for agricultural purposes; the whole zone hardly counts above 5,000 square geographical miles for colonization.

The very climatic conditions of the cultivated or agricultural zone of Eastern Siberia are less advantageous than in the corresponding region of Western Siberia. The mean annual temperature here and there approaches zero, but in the eastern zone it is a negative quantity (— 2·3), and therefore 0·5° colder than in the western. The average winter temperatures are — 18° Celsius, and that of the coldest month — 20°, or 1° and 2·5° below the corresponding temperatures of Western Siberia. The average summer temperature is 16·5°, and that of the hottest month 19°, which also fall short of the corresponding temperatures of Western Siberia by 1° and 0·5°; only the differences between the temperatures of summer and winter, 35°, and between those of the hottest and coldest months, 39°, remain approximately identical. But on the other hand, the most important factor in the capacity of the country for agriculture, the mean temperature of the five-month vegetative period, amounting in the zone under consideration to only 14°, is in this part of Eastern Siberia less advantageous than in the corresponding zone of Western Siberia.

And as regards the quantity of rain and snow falling during the whole year, the cultivated or agricultural zone of Eastern Siberia is placed in less advantageous circumstances than the same zone of Western Siberia, namely, the total precipitation is 360 millimetres instead of 380; the summer rainfall is 150 instead of 175, and only the winter shows a certain preponderancy, 56, or in other words is more snowy. The more elevated foothills of the cultivated or agricultural zone are placed in incomparably less advantageous climatic conditions, situated as, for example, Kultuk, at the southern extremity of Baikal at an absolute height of 1,600 feet, at the very foot of the Sayan, or as the mine of Preobrazhensk on the Biriussa at an elevation of 3,800 feet in a mountainous valley. Here the mean annual temperature is on an average less than — 8°, the winter almost the same, but the summer colder, the mean temperature being 12·5°, that of the hottest month 14°, in consequence of which the average temperature of the five-month vegetative period is so low, 10·2°, that it is an obstacle to agriculture.

The second zone, like the corresponding one in Western Siberia, may be called the zone of tall trees, forest industries and sporadic agriculture. It includes the Kerensk district of the government of Yenissei and part of the Yenissei district as far as 66°, or the limit of the high-stemmed forests. The area occupied by this zone in Eastern is still more extensive than in Western Siberia, namely, about 27,000 square geographical miles, and consists of a continuous mass of forest and morass, with only here and there, and that mainly in its southern part in the neighbourhood of the rivers, islets of small extent and narrow strips of land in a slight degree fit for the establishment of a settled population. The climatic conditions of this zone are also less favourable than in the corresponding zone of Western Siberia. The average temperature here is lower, — 3 instead of — 2° Celsius, the winters are more severe, having a mean temperature of — 21° instead of — 20°, the coldest month being — 25° instead of — 23°. Only the summer is somewhat warmer, 15° instead of 14°, the difference between summer and winter being therefore 36° instead of 33°, and that between the hottest and coldest months, 43° instead of 40°. From all this it appears that the climate presents a still more continental character than in the corresponding tract of Western Siberia. As for the mean temperature of the five-month

vegetative period it is here only 11° and proves extremely unfavourable to the development of agriculture, which here cannot be the main occupation of the inhabitants, but only a limited and occasional support to the forest industries. Further, in regard to the annual atmospheric precipitation falling to its share, the forest zone of Eastern is worse situated than that in Western Siberia; it here does not exceed 400 millimetres, of which moreover, half or 200 millimetres falls in the course of the three summer months.

The third or polar tundra zone is far more developed in Eastern than in Western Siberia, occupying as it does in the former an area 3.5 times that which it covers in the latter. With an extent of 24,000 square geographical miles it yields a wide field for the investigation of all the conditions of life upon the continents of the earth situated beyond the arctic circle. As a sample of the climatic conditions of this extreme north of the continent of the Old World, are the meteorological observations in one of the farthest habitable points on the Yenissei, the settlement called Tolsty Nos, lying in latitude 70°10'N. Here the mean annual temperature is only — 13°, and the mean winter temperature — 30°. The coldest month shows almost — 34°; the mean summer temperature is + 5°, and that of the hottest month + 9°. There can be no question of the mean temperature of the vegetative period, as that is so brief that it excludes all possibility of even the thought of agriculture. Under such circumstances all this country can be exploited only by polar reindeer breeding tribes or by native or immigrant hunters or fishermen.

In Eastern as in Western Siberia, the flora of the country is extremely sensitive and reflects to a nicety its climatic conditions. The alpine and subalpine flora of the Sayan range has a great resemblance to that of the Altai, while at the same time exhibiting certain departures from it. Thus in the Alpine Sayan flora, appear certain polar forms not met with in the arctic zone of Europe and Western Siberia, but peculiar to the arctic zone of Eastern Siberia and America; many Altaic species vanish, which rise high on the Altai slope from the steppes of Central Asia, adjacent to that region, and on the other hand vegetable forms appear which do not occur at all in the Altai, but are either entirely local or common to the Sayan and the Stanovoi ranges, and even to the more remote Tian-Shan. To the latter forms belongs the prickly shrub with gray foliage and yellow flowers characteristic of the Alpine zone, known under the name of the camel's tail among the Tiurk tribes Tiuek-uiriuk, (caragana jubata Poir).

The flora of the Sayan slope, that is, of the cultivated or agricultural tract of Eastern Siberia also possesses essential distinctions from that of the Western Siberian lowland. Gmelin already noticed that on crossing the Yenissei the flora considerably alters. And in fact, to the east of the Yenissei not a few characteristic Siberian plants occur, not to be met with in the Western Siberian lowland. But this is explained not so much by any sharp change in the climatic conditions, which really does not exist, as by the circumstance that the slope of the Sayan ridge where it is intersected by the great Siberian tract, does not exhibit a flat low lying expanse like Western Siberia, but is scored by more or less elevated offshoots of the Sayan, by which its mountain flora pushes its way deep into the cultivated or agricultural zone of Eastern Siberia. Examples such as struck the eye of such an experienced naturalist as Gmelin might be quoted in large number. Thus, of the family of crow's

foots (ranunculaceae) beyond the Yenissei are met with for the first time: thalictrum contortum L., anemone sibirica L., caltha natans Pall.; of the fumitories (fumariaceae): corydalis ambigua Cham., corydalis gracilis Led.; of the crucifers (crucifereae): two species of dontostemon, sisymbrium humile Mey.; of the violels (violarieae): viola dissecta Led.; of the pea family (leguminoseae): some astragalus (oxytropis muricata D.C., brevirostre D.C., ammophila Turcz., grandistore D.C., leucantha Pers., caepitosa Pers., ampullata Pers. These latter are merely mountainous forms of the Altai-Sayan system, which have descended into the Siberian lowland on the right hilly bank of the Yenissei by means of the Sayan spurs.

Least difference of all is noticeable between the flora of the forest zone of Eastern and Western Siberia. The woody races are absolutely identical. Of the coniferous families the pine (pinus sylvestris L.), and the Siberian larch (larix Ledebourii Endl.) do not cross the boundary of the forest zone; but the remaining forms also pass over into the polar zone, becoming of course stunted, crooked and gradually losing their proper character of high-stemmed trees. Thus the Siberian fir (pinus sibirica Led.), attains on the Yenissei a height of 67·5° north latitude, the Siberian cedar (pinus cembra L.), 68·5°, the pitch pine (picea orientalis L.), 69·5°; finally the daur larch (larix davurica Fisch.) is found on the river Boganida as far north as 72·5°. As far as regards the herbaceous plants of the forest zone, it is not distinguished by any special differences from the like flora of the corresponding zone of Western Siberia, and is on the whole poor; in the thick forest growths there is no herbage, the soil being mainly carpeted with mosses and lichens.

Particularly typical on the other hand is the very limited flora of the far north of the polar tundra tract. Middendorf found on the Taimyr peninsula 124 plants, among which were the very lowest, it might be said, dwarf shrubs of the arctic species of birch (betula nana L.); willow, (salix polaris Wahl, lanata L., glauca L., arctica Pall., taimyrensis Trautv.), and also a ledum, (ledum palustre L.) and an andromeda (cassiope tetragona Don.); and of herbaceous plants, 17 species of cruciferene, 14 compositeae, 7 stellarieac, (alsine, stellaria, cerastium), 12 stonecrops (saxifraga), 6 species of pedicularis, 5 astragals (of the genea phaca and oxytropis), 5 rosacèae (dryas, sieversia, potentilla) and 6 crow's foots (ranunculus, caltha, delphinum). Of the 124 plants mentioned, 30 do not belong to the polar types, but are common to the whole of Siberia and for the most part cross over on the one side into Europe, and on the other into America. The remaining 94 plants are completely arctic types. Much more than half of them (54) are met with over the whole polar zone, alike of the Old and of the New World, and in part come forth upon the alps of the Altai Sayan range; but some are peculiar to Siberia alone (12), or only appear outside in Europe (10), or more frequently in America (18 species). To the latter, for example, belong of the crow's foots (ranunculaceae): ranunculus affinis R. Br.; of the crucifers, (cruciferene): draba pauciflora R. Br., draba glacialis Ad., draba algida Ad., draba rupestris R. Br., hesperis Hookeri Led., sisymbrium sophioides Hook.; of the caryophyllaceae (alsineae): alsine macrocarpa Fenzl., alsine arctica Fisch.; of the pea family (leguminoseae): oxytropis nigrescens Fisch.; of the rosaceae: sieversia glasialis R. Br.; of the stone crops (saxifragaceae): saxifraga serpyllifolia Pursh. punctata L.; of the scrophulariaceae: pedicularis Langsdorffi Fisch., pedicularis capitala Ad.

The insect fauna follows on the whole the same laws as the flora, but in the Sayan range it is somewhat poorer than in the Altai, and on the slope presents less difference from the fauna of the Altai slope than does the flora. Highly eccentric arctic forms are met with among the coleoptera devoid of flight, as for example the carabidae: carabus Baerii Men., lyperophorus cribellus Men., lyperophorus costatus Men., platysma borealis Men. Not less peculiar are the following arctic forms of other categories of insects, of the moths (lepidoptera): amphidasis unfasciata Men.; of hymenoptera: ichneumon Middendorfii Er., ichneumon figulus Er.; of the diptera: musca boganidae Er., anthomya ursula Er., lispe frigida Er., nephrotoma aquilonia Er.; of the neuroptera: hemerobius algidus Er.

As the forest and polar tundra zones in Eastern Siberia reach their full development the questions, having reference to the distribution of the vertebrates over Siberia, are most clearly answered by the study of these zones. At first sight it might be expected that in such deserted spots as are the forests and tundras of Siberia, where there is no regular hewing of timber, where there are not more than seven men living per square geographical mile, the fauna should be extraordinarily rich, if not in the variety of species, as in more southern countries, here opposed by climatic conditions, then at least in numbers. Unfortunately even in the forest zone the fauna of Siberia is very poor in both respects, and if the sportsman with gun in hand should traverse the whole forest zone of Siberia to its very heart, for example, to about 60° north latitude, he would be very much disenchanted by the fact that at times whole days would pass without his making any bag. In the unbroken and thick forest growths of Siberia, there are hardly any wild animals. They keep gladly to the skirts of the woods, the forest glades, to areas devastated by forest conflagrations, nay, even to the clearings wrought by man, near to his habitation, but not in the forest depths, and not in the forest thicket.

Such spots, free from trees and also convenient fords across rivers at certain seasons of the year, serve the wild animals as places of assembly, and the whole skill of the native trapper is confined to watching for them here at the right time, knowing these spots and the season of their frequenting by animals. This method of hunting explains also why the sparse population of the forest regions of Siberia, unable to exhaust its woody wealth, is gradually exhausting its animal life. This circumstance leads to the thought that the establishment of vast forest clearings or glades, hunters lands and the preservation of the animals assembling upon them at certain seasons of the year, might not only conduce to the preservation from destruction, but also to the increase of valuable races of animals.

Generally speaking in the forest and polar tundra zones of the whole of Siberia, which are comparatively so poorly endowed by nature, the natural riches are so scattered over the enormous surface in a thin and sparse layer, altogether wanting in some parts, that it is as difficult to collect them as it is to amass the separate grains of gold in auriferous strata, such work being only feasible when they have been agglomerated by accident or by nature or else by the ingenuity of man.

Passing on to the mammalia of the forest and polar tundra zones of Siberia, the few animals peculiar to the tundra region may be first of all described. The most arctic animal is the white bear, (ursus maritimus L), properly an inhabitant of the islands of the Arctic Ocean; it is carried by the floating ice to the arctic shores of Siberia and is found, for

instance, at the mouth of the Yenissei where it was the first living creature seen by Nordenskjöld's expedition on the Siberian shore at the entrance of the gulf of Yenissei; it sometimes even reaches the settlement of Tolstyi Nos, which is the first inhabited spot on the Yenissei from the ocean, but it does not penetrate further. Next come those arctic wild animals which almost exclusively inhabit the polar tundra region: the arctic fox, (canis lagopus L), found in the Taimyrsk peninsula under 75° northern latitude, and the small striped or Obi lemings, (myodes torquatus and myodes obensis). There was formerly another large animal contemporaneous with mankind existing in the polar tundra region corresponding to the musk ox, (bos moschatus), which is found in the polar regions of America, but has now entirely disappeared; this Siberian ox (bos pallasii) was distinct from the American variety, but is only known by the skulls and bones found in the Taimyrsk tundras. Finally as characteristic animals of the tundras the northern hare, (lepus variabilis Pall.) and the reindeer, (cervus tarandus L), may be mentioned, although they spread far down into the forest zone. The latter is found in the mountainous parts of South Siberia; on the Urals it goes down south as far as 52° northern latitude, on the Altai to 49°, on the Sayan and Stanovoi chain to 53°, and in the Amour region it reaches the mouth of the Ussuri under 49° north latitude.

The rest of the mammalia dwelling in the Siberian plains may be regarded as animals of the forest zone, although many of them penetrate into the polar tundra region. These are the glutton, (gulo borealis Nilss.), the common bear, (ursus arctus L), the very rare sable, (mustella zibellina L), the ermine, (mustella erminea L), the Siberian weasel (mustella sibirica Pall.), the common weasel (mustella vulgaris Ertl.) the otter, (lutra vulgaris, Erkl.) although rare, the wolf, (canis lupus L), the fox, (canis vulpes L), the black variety being only peculiar to the extreme north, the lynx, (felis lynx L), the elk (cervus alces L), the flying squirrel, (pteromys volans L), the common squirrel, (sciurus vulgaris L), the striped squirrel, (tamias striatus L) and some small species of rodents. Finally on the low mountain ridges intersecting the polar and forest regions of Eastern Siberia, for instance, on the Severma chain east of the Yenissei under 67° north latitude, and on the mountains following the current of the lower Tunguzka there are animals belonging to the mountain fauna, namely the mountain sheep, (aegoceros montanus Desm.) and the musk, (moschus moschiferus L.).

On the Altai-Sayan elevations in Eastern and particularly Western Siberia, there are naturally species of such mammals as are not found on the Siberian plains. These are the Alpine wolf, (canis alpinus, Pall), two races of large cats, (felis irbis Müll and felis manul), the chtonoergus alpinus, spermophylus Eversmanni, the alpine hare (lagomys Alpinus Pall), the stag, (cervus elaphus) and others.

Birds, being more widely spread than any other vertebrates, are fairly plentiful in all three zones of Eastern and Western Siberia. The birds of prey, which are found as far as the Taimyr peninsula, are: one of the eagle tribe, probably aquila albicilla Bris. and a buzzard (buteo lagopus), two sorts of falcons, (falco gyrfalco L., falco tinuncula St.) and some bats, (stryx brachyotus Forst, stryx nictea L., stryx funerea Lath). The small birds, passeres, which nest far north in Siberia are some varieties of larks, (alauda alpestris L., plectroph nivalis L., plectroph lapponica, emberhiza polaris Mid., fringilla linaria L., parus sibiricus Pm., motacilla alba L). The fowls which are found partly in the polar zone and especially in the forest zone are partic-

ularly the lagopus albus L and lagopus alpinus Nilss., the heath cock, (tetrao urogallus L, tetrao tetrix L., and tetrao bonasia L.). There are numerous long-legged birds in Siberia, but principally of the same kinds as those in Europe. Siberia is however particularly rich in water fowls which nest in countless numbers on the shores of the Arctic Ocean and also on the banks of the rivers and lakes. On Lake Baikal the gulls are so numerous that the crags and rocks overhanging it are covered with a thick layer of guano which for a long time will serve as manure for the future generations of Siberian farmers. The remarkable 300th geographical phenomenon of Lake Baikal is the existence of a species of seal (phoca baicalensis), in the water of this inland sea.

The total population of Eastern Siberia, omitting the Yakutsk region, is about 900 thousand of both sexes, of whom not 8 per cent, as in Western Siberia, but 23 per cent are natives, the remaining 77 per cent being arrivals from Russia. The Mongolian tribe of Buriats is the most numerous indigenous race, settled here since the thirteenth century, when the world-renowned Kingdom of Chengis-Khan originated in Mongolia. The first Russian settlers, when first taking possession of the part they were about to colonize, during the seventeenth century, waged desperate war with the Buriats, which ended in their being completely subdued at the end of that century. At present there are about 160,000 Buriats of both sexes, exclusively inhabiting the agricultural zone of Eastern Siberia. Their principal occupation is cattle breeding; they are of the Buddhist faith and are only partly engaged in agriculture. The space covered by the Buriat camps is limited, and they are in reality but half-nomadic, whilst part of them already lead a settled life. About 20 per cent of them have been converted to christianity and have become to a great extent russianized. The most northern Buriats still adhere to shamanism. It is a remarkable fact that the Buriats do not exhibit any tendency to die out, but on the contrary increase at almost the same rate as the Russian population.

The Turco-Finnish tribes form another indigenous element, known by the collective name of Tartars. They number about 22 thousand and dwell exclusively at the foot of the Sayan mountains in the Yenisseisk government. The celebrated Russian savants and authorities on Finnish and Tiurks dialects, Kastren and Radlov, studied their language and proved that it was undoubtedly allied to the Finnish. The Finnish tribes were at one time spread over all the continent from the Sayan chain through Western Siberia, the Urals and the plains of Russia in Europe as far as the Gulfs of Finland and of Bothnia and the Baltic Sea. In the country at the foot of the Sayan mountains the subjection of this race to the Tiurksk tribe in Erghene-Kona has transformed them into the so-called Tartars. The Tartars of Eastern Siberia have, however, already adopted a settled mode of life; the majority of them have been converted to christianity and become russianized; the gradual progress of their assimilation is still further facilitated by their decreasing numbers, which were never very large. The third indigenous element is composed of a mixed collection inhabiting the forest and polar zones of Eastern Siberia consisting of 3,000 Tungues, 1,000 Jakuts and about 4,000 Ostiak-Samoyedes, forming a native population of 8,000 leading a nomadic life in the forest and polar tundra zones.

The greater part of the population of Eastern Siberia, over 770 thousand of both sexes inhabit the cultivated zone at the foot of the mountains where the density of population

amounts to 73 per square mile, being almost equal to that of the Altai mining district with which it has the greatest similarity. The indigenous population is however much larger and amounts to 21 per cent, as this region was inhabited by the Mongolian tribe of Buriats as early as the thirteenth century. The population of those districts comprising the wood industry zone of Eastern Siberia, excepting the Touroukhansk district, the southern part of which may be annexed to the forest zone, amounts to 120 thousand of both sexes, or about 7 per square mile, which is comparatively still less than that of the forest zone of Western Siberia and is due to unfavourable conditions. The whole of the Touroukhansk region does not contain more than 9,000 inhabitants, and of these over 90 per cent are natives, which is sufficient to show that the polar tundra zone is entirely unsuitable for a settled population.

In Eastern Siberia the relative population of the towns is somewhat higher than in the west, and amounts to 10.5 per cent; this clearly shows that agricultural colonization is less developed. The population of the regular towns is as follows: Irkutsk 44 thousand, Krasnoyarsk 15 thousand, Minussinsk 10 thousand souls.

The distribution of domestic animals depends upon the density, mode of life and distribution of the inhabitants, and in this respect the conditions of Eastern and Western Siberia are very similar. In the former there are 72 horses for every 100 inhabitants, or 3 to 4 horses for every grown man, in all 640,000 horses, or more than in Western Siberia. There is a still greater proportion of large-horned cattle, namely, 70 head for every 100 inhabitants, or 630,000 head of cattle in all, which amount to no less than 3 cows per every married couple, whilst in Western Siberia there are only 52 per 100 inhabitants. The proportion of small cattle is still more favourable in the east being 135 per 100 inhabitants, or over 1,200,000 head, and in Western Siberia it is only 85 per 100 inhabitants. This difference is explained by the fact that cattle raising is in a high state of development among the Buriats who number 18 per cent of the total population of Eastern Siberia. As regards the reindeer, the total number of head of this species does not exceed 34 thousand in Eastern Siberia, as there are very few breeders, not more than about 6 thousand. The number of reindeer is about the same as in Western Siberia or 600 for every 100 inhabitants. The draught dogs are of great use to the inhabitants of the polar tnndra zone. These animals are sharp-nosed, with elevated ears and downy hair; they are of different colours, white, black, spotted, gray and brown; they never bark, are very hardy and strong, with a fine scent, and are satisfied with a very small amount of most unappetizing food. They are harnessed in numbers from 3 to 11, without any reins or bridles, with one dog as an outrunner to show the way, the driver being only provided with an iron-pointed rod which serves as a break. Each dog will draw a load of 3 pouds; they run in harness at a speed of 10 to 15 versts per hour. The outrunning dogs are the most highly prized and they cost from 60 to 70 roubles apiece.

CHAPTER IV.

The Yakutsk Frontier Country.

Orographic and hydrographic review; division into two regions or zones, the region of high-stemmed trees and forest industries with a mixture of cattle raising and the polar tundra zone; the climatic conditions of each of these regions; vegetation and fauna; composition and distribution of the population; the natives of the Yakutsk border land; the Arctic Ocean, its islands, flora and fauna.

TO the east, south-east and south-west of Siberia proper, which has just been described, stretch enormous tracts of land which have as yet been but little touched by Russian civilization, and which may be termed the border lands of Siberia.

The most extensive of these is the Yakutsk frontier country. It consists exclusively of the Yakutsk region which is under the administration of the Governor-Generalship of Irkutsk, formerly that of Eastern Siberia. With regard to its geographical position the Yakutsk border land occupies a large part of the country watered by the gigantic river Lena and also the basins of some of the smaller tributaries of the Northern Ocean, such as the Olenek, the Yana, the Indighirka, the Alazea and the Kolyma. Its surface covers the enormous area of 70 thousand square geographical miles; this considerably exceeds that of the governments of Yenisseisk and Irkutsk taken together, or that part of Siberia proper called Eastern Siberia. It is bounded on the south-east and east for more than 3,000 miles by the Stanovoi or Yablonoi mountains, which throughout the whole of their length serve as a barrier between the waters flowing from the north-western side into the Northern Ocean, and those flowing from the south-east and east into the Okhotsk and Behring Sea of the Pacific. The Stanovoi or Yablonoi chain is not very elevated, the summits of Kogahin, Gonam and the road leading to the prison of Udsk have an altitude of 2,500 to 4,000 feet above the level of the sea, whilst some of the highest peaks have an elevation of 5,000 to 7,000 feet. On the Stanovoi chain and the mountains adjoining it, as for instance the Verkhnoyarsk chain, not only do the numerous branches of the large straight tributaries of the Lena, like the Olekma and Aldan, take their rise, but also those of the ocean rivers, the Yana, the Indighirka and the Kolyma. The Lena itself rises in the borders of Eastern Siberia in the Baikal mountain range, the summits of which, as for instance the Vetkin peak, are not more than 4,200 feet above the level of the sea. The outlying mountains of the Stanovoi chain, stretch-

ing into the Zabaikalsk region between the Vitim and the Olekma, have some summits as high as this. Generally speaking, the whole of the Yakutsk region is not such a continuous plain as a large portion of Western Siberia, and is even far less level than the forest and tundra belts of Eastern Siberia. The whole of the southern part of the Yakutsk region, south of the latitude where the Lena blends with the Aldan, is indeed fairly mountainous, and north of this latitude there are also many chains of mountains. Those to the east of the Lena, such as the Verkhnoyansk chain, which seperates the Aldan from the sources of the Yana and Indighirka, the mountains of Kolymsk, Alazeysk, Tak-Tayakhtakh are all more or less connected with the Yablonoi chain, whilst those chains stretching to the west of the Lena, like the Viluisk range and the summit dead levels of the Vilui and the Olenek, are distinct independent upheavals.

The geognostic composition of the mountains of the Yakutsk region is principally made up of crystalline formations, granites, syenites, diorites, diabases, gneiss, crystalline schists and sometimes porphyries and even trichytes, whilst in the Aldansk range, besides these crystalline formations, there are also volcanic rocks such as basalts and dolerites. The slopes and outlying parts of the Stanovoi chain and other ranges in the Yakutsk region like the Viluisk mountains are principally composed of upheaved sedementary strata, partly belonging to the paleozoic formations, upper silurian, devonian and carboniferous, but more especially to the secondary formations, particularly the jurassic and partly to the tertiary. The Yakutsk region is well endowed with mineral wealth.

The silver-lead ores, iron and coal, found iu the Stanovoi mountains, are well diffused over the Yakutsk region but the auriferous sand is the only substance worked, particularly the rich deposits near the river Olekma and some other tributaries of the Lena.

The Yakutsk region is abundantly watered by magnificent full rivers which are in summer the only means of communication. The gigantic Lena is 4,300 versts long and with its tributaries, the Vitim, Olekma, Aldan and Vilui, forms one of the richest river systems of the Old World, watering an area of over 43 thousand square geographical miles. Unfortunately the Lena system possesses even to a greater extent the same disadvantages as the systems of the Yenessei and Obi, as they all flow to the north and fall into the Arctic Ocean, which cannot be navigated with any regularity. It is also made up of two enormous component branches, the Lena and the Aldan, which meet still farther north than the branches of the Obi, in a country quite unsuitable to settled cultured life. Besides this the mouth of the Lena does not form a wide, open estuary like the mouth of the Yenessei, or a large gulf like the Obi, but an enormous delta, projecting into the Arctic Ocean, which with its labyrinth of islands, intersected by numerous channels, makes the mouth of the Lena far less accessible from the sea than that of the Yenessei. The other large rivers falling into the Arctic Ocean, the Yana and Indighirka, also have a tendency to form deltas.

The climate of the Yakutsk region is the most continental of the Arctic and sub-Arctic zones of the Old World. It may be divided into two regions or belts, the one corresponding to the region of high-stemmed trees, forest industries and sporadic agriculture of Eastern and Western Siberia, and the other to the polar tundra belt of reindeer breeding and dog-conveyance. The first region comprises the districts of Yakutsk, Olekminsk and a large southern

portion of that of Viluisk, and the second consists of the districts of Verkhoyansk, Kolymsk and the basins of the Olenek and Lena below Zhigansk in the Viluisk and Yakutsk districts. The first, south-western zone, has an area of 38 thousand square geographical miles, the second, north-eastern zone, covers 32 thousand. Taken from four points of observation situated in the first part of the Yakutsk region, the mean yearly temperature is about —8° Cel., the mean winter temperature is —33°, that of the coldest month —36°, the mean summer temperature +15°, that of the hottest month +17°; the difference between the temperatures of winter and summer is 48°, the difference between the coldest and hottest months is 53°; that is to say, the climate is far more continental than that of the neighbouring forest zone of Eastern Siberia. Under these climatic conditions, the soil which the sun's rays do not penetrate to a greater depth than three-fourths of an arshine, is always frozen. Nevertheless the mean temperature of the five-months period of vegetation is + 11°, and even + 12° in Olekminsk and Yakutsk, whilst the high summer temperature of +15° during the powerful insolation of the short summer period permits of sporadic agriculture in some parts of this portion of the Yakutsk region.

One of the cold poles of the northern hemisphere is situated in the north-eastern polar-tundra part of the Yakutsk frontier country. Thus, in Verkhoyansk under 67° 34′ north latitude the mean yearly temperature falls to —17° Cel.; the mean winter temperature is —47°, that of the coldest month —49° Cel., whilst the mean summer temperature hardly exceeds +13° and that of the hottest month +15°; the difference of temperature between winter and summer is 60°, and between the hottest and coldest months 64°; this is a type of the most continental climate in the Old World. Three and a half degrees farther north at Ustiansk, under 70° 53′ north latitude, the climate is already milder. The mean yearly temperature exceeds —16° Cel.; the winter temperature is —37° Cel.; that of the coldest month is —41°; the summer temperature is +9°, and that of the hottest month +13; the difference between the temperatures of winter and summer is only 47°, and that between the hottest and coldest months 54°. On the other hand the mean temperature of the five-months period of vegetation, which in Verkhoyansk hardly exceeds 8°, does not amount to more than 3° at Ustiansk, or in other words, the mean temperature of 9° lasts about five months at Verkhoyansk and only three months at Ustiansk.

At the mouth of the Lena, at Sagastyr, where there was for nearly two years a meteorological station of the Russian Imperial Geographical Society, the climatic conditions are still more unfavourable. The mean temperature (below —17°), the winter temperature (—36°) and that of the coldest month (—42°) at Sagastyr are closely approximate to those of Ustiansk, but the mean summer temperature of less than +3°, and that of the hottest month of less than +5°, place all organic life under the most unfavourable conditions of existence, especially as at a depth of 0.8 metre the soil never thaws and in winter has a temperature below —20° Cel. Under these circumstances, cultured life in the polar tundra zone of the Yakutsk frontier country is quite impossible. At Yakutsk in the forest zone the Lena is clear of ice during 160 days in the year, whilst at Ustiansk the Yana is only clear during 100 days. The climate of the south-western forest part of the Yakutsk region is also less favourable than that of East Siberia, with reference to the amount of rainfall

during the year, which only amounts to 310 millimetres compared to 360 millimetres deposited in the forest zone of Eastern Siberia. The winters are also less snowy (38 millimetres against 56); the summer rainfall is however almost the same in both places. According to observations made at Sagastyr near the mouth of the Lena, there is very little moisture deposited in the polar tundra zone, not more than 86 millimeters in the year, 45 millimeters of which fall during the three summer months, which clearly shows the extremely continental nature of the climate of the Yakutsk frontier country, and especially of its north-eastern portion.

The vegetation of the south-western part of the Yakutsk region differs in general but little from that of Eastern Siberia. The trees are the same as those of Siberia proper and only outside the borders of the Yakutsk region on the south-western slopes of the Stanovoi range there exist certain varieties which disappear in Siberia as soon as the Ural mountains are reached. Generally speaking, the zone of forests of full grown trees and forest industries in the Yakutsk frontier country is completely covered with continuous, dense and often impenetrable forests and extensive morasses above which rise, in some places, little islands from the surface of the sea, barren mountain heights either connected in chains or standing isolate and bare.

The flora of the grasses in the forest zone is naturally poor in the thick of the woods where grass hardly grows at all, but in the forest glades and clearings and on the open marshes, river banks, mountain slopes and rocks, the flora is rich and characterized by local plants which make their appearance beyond the Yenessei along the mountain slopes of the Sayan chain and spreading over all the mountain ranges intersecting the Yakutsk frontier country. These plants include, for instance, some of the spear-wort family, namely, three varieties of thalichtrum, (petaloideum L., rufinerve, L. et sparsiflorum Turcz), two anemones (anemone Sibirica L., and pulsatilla davurica Spr.), chickweed (caltha natans Pall), isopyrum fumarioides, L. two aquilegiae (aquilegia sibirica Lm and parviflora Led.), one variety of larkspur, (delphinium grandiflorum L.), three kinds of aconites (aconitum volubile Pall., villosum Rch., Kusnetzovi Turcz.); some of the plants found here only grow within the borders of the Yakutsk frontier country, like delphinium crassicaule Led and others, and are American types like rannunculus Purshii Hook and affinis R. Br. and other numerous families of plants. The polar tundra zone is of a very different character; in summer the tundras are free from snow but the soil is always frozen to a depth of half an arshine below the surface and consists of alternate layers of earth and ice. In these strata besides the semi-fossil sea shells, of types still existing in the Arctic Ocean, bones and skeletons and even bodies of extinct animals of Northern Siberia are found, such as the mammoth and rhinoceros, often in an excellent state of preservation.

The surface vegetation of the tundras consists principally of moss, of the polytrichum, bryum and hypnum varieties. From underneath the dark brown surface, grass crops up in places, here and there forming grass plots, but more oftet growing in seperate patches on the bare clay soil. This kind of grass flora not only closely resembles that of the corresponding parts of Siberia proper but is also much like the flora of Western Europe. Thus, out of 92 distinctly flowering plants collected by Nordenskjöld's expedition, at their winter quarters beyond the eastern extremity of the Yakutsk frontier country, but still on the shore

of the Arctic Ocean, more than two-thirds, namely 63, were varieties common to the Arctic zone of Europe but not descending into Russia in Europe; 17 were American varieties also common to the arctic zone of Siberia, but not known in European Russia, whilst 12 were exclusively Siberian arctic forms. Very few of these latter are peculiar only to the north-eastern corner of Siberia. The first vernal plant which flowered near Nordenskjöld's winter quarters was the spoonwort (cochlearia fenestrata R. Br.). This happened on the 23rd of June, new style, and only a week after this, about July 1, did nature thoroughly awake, the tundras became green, flowers blossomed and insects made their appearance, first of all flies and then coleoptera, amongst which there were two rather large kinds of cockchafers (carabus, C. truncatipennis Esch). The local flora is characterized by the large amount of gramineous plants, which in some place form a continuous sward. There were in all 13 different kinds found and amongst these the original varieties were glyceria vilfoidea Th. Fr., Gl. vaginata I. Lge, arctophylla effusa I. Lge. There are plenty of bushes of different kinds of low polar willows, the rarer varieties being salix chamissonis And., salix cuneata Trautv., and salix boganidensis Trautv.

The fauna of both zones of the Yakutsk region also closely resemble that of the corresponding zones of Eastern Siberia, but the fur animals are more abundant and of a better quality, probably because the outline of the Yakutsk frontier country is more varied and the mountains and rocks which rise above the forests afford more free spaces for the species of this region. In describing the animals which at present inhabit the forest and tundra zones of the Yakutsk frontier country it is impossible to ignore those varieties which are now extinct in these zones of Siberia. The genus elephant (elephas primigenius Bl) at a recent geological epoch, when man already existed, inhabited the whole of the palearctic zone of the northern hemisphere and, in contrast to the southern Indian elephants, it was covered with thick, long, red hair. A splendidly preserved specimen of a whole mammoth with perfect skin and hair was lately found in the polar tundra zone of the Yakutsk frontier country, and in 1892 a special expedition was sent by the Academy of Sciences to examine it. The two varieties of the rhinoceros (rhinoceros antiquitatis Blumb. and rhinoceros Maerckii Jäg.), which flourished here at the same period, are no less interesting. They are discovered under the same conditions as the mammoths; a fine head of one of these animals, found in the southern part of the Yakutsk region, is preserved in the Academy of Sciences having been presented by the Siberian Section of the Russian Geographical Society.

As regards the population of the Yakutsk region, which has been in the possession of the Russians since the seventeenth century, the number and composition of the inhabitants clearly show how little this country is suitable for settled colonization. The total population does not exceed 250 thousand of both sexes, of which the Russian element only numbers 15 thousand or about 6.5 per cent, the remaining 93.5 per cent being made up of other tribes. The greater part of these are the Yakuts, numbering about 220 thousand; they are of Tiurksk origin, their language is a Tiurksk dalect with a mixture of Mongolian words. They have preserved all their ethnographical features to a remarkable extent, type, language, manners and customs and even dress. This Tiurksk tribe was driven to the far north by the Mongolians at the time when their rule in Central Asia was supreme. Whilst preserving a nomadic

form of life the Yakuts however adapted themselves to the hard conditions of life of the northern forest zone and, exchanging the grassy steppes of Central Asia for the forests and tundras, they became a race of hunters and cattle breeders. Cattle rearing is however their chief occupation, after which come hunting and fishing and lastly agriculture, which is but little developed. The Russians, being weak in numbers, have not had an influence upon the Yakuts, except in converting the greater part of them to christianity, but even this conversion is more apparent than real as the Yakuts are still to a very great extent addicted to shamanism, and their former faith. The Tungues lead almost the same form of life as the Yakuts and number over 10 thousand of both sexes. The other races inhabiting the Yakutsk frontier country, counting about 3,000 men, consist of polar tribes like the Lamuts, Ukagirs, Tchuktchis, Tchuvantsis and Koryaks. These tribes principally occupy the north-eastern polar tundra portion of the country.

The population is very unevenly distributed between the two zones of the Yakutsk frontier country; whilst the region of high forest trees, forest industries and sporadic agriculture has 230 thousand inhabitants of both sexes, or about 6 men per square geographical mile; the population of the polar tundra region does not exceed 20 thousand, or about 6 men for every 10 square geographical miles, and is entirely composed of other tribes, as the Russian population principally dwells in the forest zone and the towns. The people of the towns do not however exceed 8,000 of both sexes, or rather more than 3 per cent of the total population of this region, and indeed all the towns with the exception of Yakutsk, which has 6,000 inhabitants, are nothing more than small Russian settlements serving as points of support for the Russian rule in the country. In these settlements in the zone of high forest trees the Russians occupy themselves to some extent with agriculture and partly with cattle breeding, but their occupations in the polar tundra zone do not differ from those of the natives. It is a remarkable fact that, whilst the Russian population of Siberia proper, living under conditions of life approaching those of its native land, has not only gradually increased in numbers, far exceeding the native tribes, but has succeeded to a great extent in assimilating them and even in the Amour-littoral and Kirghiz steppe regions has preserved intact all the national qualities and appearance, here in the Yakutsk frontier country under the heavy yoke of nature the Russian settlers seem to have deviated from their nationality. Placed under the most unfavourable conditions for civilization, they have in some places assimilated themselves with the native tribes and, adopting their mode of life, have descended to their level. This is particularly the case with the population of Verkhoyansk, Ustiansk, Zashiversk, upper, middle and lower Kolymsk, and naturally, mixed marriages with the natives have greatly contributed to this state of things.

The distribution of domestic animals is closely connected with that of the inhabitants over the surface of the country, and with their mode of life and their relation to the ground upon which they dwell. In the Yakutsk frontier country there are more than 50 horses per every 100 inhabitants, or 130 thousand horses in all, or about the same quantity as in Western Siberia, but the quantity of large-horned cattle, 260 thousand beasts in all, exceeds 100 head per 100 inhabitants or more than double the quantity in Western Siberia, and one and a half times more than in Eastern Siberia; this amounts to 5 head of horned cattle per every

married couple, and clearly shows that the Yakuts are a cattle rearing people of the steppes of Central Asia, accidentally driven to the forest zone of the cruel north. The transition of the most northern Yakuts to reindeer breeding in a region unsuited to horned cattle and horses, confirms this theory. The reindeer in the polar tundra zone number about 50 thousand head, or about 200 head for every 100 inhabitants of reindeer breeding population. Small animals are not raised in the Yakutsk region except the dogs used for travelling in the polar tundra zone, which are kept by the indigenous tribes in even greater numbers than in Eastern Siberia.

All that has been said about the Yakutsk frontier country, where there is no regular agricultural zone, clearly shows that this region has but very little importance for settled Russian colonization and that this most extensive portion of Siberia is destined by nature itself to be inhabited by wandering or nomadic tribes or by those who from time immemorial have been aborigenes of polar countries, hyperboreans or nomads, who have found their way hither from the plains of Central Asia and succeeded somehow in acclimating themselves in the forest zone of the north. This region can be of only one use to Russia, on account of the impossibility of peopling it by means of settled agricultural colonization, which was effected under such favourable circumstances in the agricultural zone of Siberia proper and in the country round about the Altai mountains; the Yakutsk region might, like British America, excepting Canada, be organized for working the natural riches of the country which, without doubt, exist there but they are distributed, as has been already mentioned, in scanty and scattered layers over the enormous surface of the coldest land of the Old World.

There is no positive evidence to show that the stranger tribes of the Yakutsk region are decreasing in numbers, or in other words dying out; but of late years this opinion has been expressed by people well acquainted with Siberia. If this only referred to the small polar tribes of the Yakutsk frontier country, such as the Lamuts, Ukagirs, Koryaks, Tchouvans and Tchuktchis it would be highly probable. Before the arrival of the Yakuts these tribes were spread much more to the south and occupied a far greater expanse of country, and on being driven from their former place of habitation by the Yakuts they congregated about the north-east polar tundra part of the Yakutsk frontier country and the Chukotsk peninsula. Every country has, however, a limit of capacity in relation to the population inhabiting it, depending upon the conditions of climate and soil and the state of culture of the inhabitants, and the frozen tundras, inhabited only by hunters presents the most limited accomodations for population in all the continent of the Old World. When once this limit was reached, which happened as soon as the numerous Yakuts who occupied the land drove the aborigenes to the north-east into the polar tundra zone, these aborigenes ought to evince symptoms of dying out, as the country in which they were congregated was not, with their means of procuring food, capable of nourishing them. There is yet another argument in favour of the Yakuts. The forest zone affords far greater capacity for population than the tundras, and this capacity was considerably further increased when the Yakuts arrived, in virtue of the difference of their state of culture from that of the former aborigenes of the country, as every country has greater capacity for a race of cattle breeders than of hunters. The Yakuts, therefore, having driven out the natives into the polar tundra zone, had ample space in the

forest zone of the Yakutsk frontier country and their dying out could only arise from their being unable to accomodate themselves with the conditions of the country and acclimate themselves. But this was not the case, as they became indigenous, and the occupation of the country by the Russians did not in any way deteriorate their position. The Russian settlers, whose number does not exceed 6·5 per cent of the indigenous population, congregated together in a few spots of this region and could not in any way oppress the Yakuts who have up to late years shown a natural increase. But the lives of nations, living, not as cultured people, but as children of nature (naturvölker) are sometimes visited by scourges of nature which they are not in a condition to withstand. Epidemics like small pox, epizootic which destroys the principal means of existence of cattle breeding races, or temporary scarcity of wild animals or fish can all tend to decrease the population during certain periods, and when these evils are removed it again shows signs of increasing. However the question as to whether a temporary decrease in the population has brought about the idea that the natives of the Yakutsk frontier country are dying ont, or whether a cattle breeding race inhabiting a forest country, not entirely corresponding to their pursuits, has attained the limit of capacity of the country, can only be decided by the future.

To the north of the shore of Siberia proper and the borderland of Yakutsk stretches the boundless surface of the Arctic Ocean. This cannot be regarded as being perfectly smooth, not only because in many places more or less elevated islands or groups of islands rise out of it, but also because during nearly the whole year, except short and irregular periods, the surface of the ocean is covered with ice. If it were not for this ice, which is an insurmountable barrier against navigation, and if the plains of Siberia as they gradually approach the ocean were not transformed into barren tundras, from which not only is forest vegetation banished but even all forms of organic life, and if the mouths of the Siberian rivers were not ice bound during the greater part of the year, then the geographical position of Siberia would be most brilliant for ocean communication and universal trade.

Unfortunately the whole of the Arctic Ocean along the coast of Siberia is blocked with ice during the greater part of the year. It is true that along the whole of the Asiatic from the Yugorsky Sound to Cape Dezhnev at the entrance to the Behring Sea there are no glaciers descending into the sea, so that there are but very few icebergs on the coast of Siberia and those which are formed are very small, rarely more than 100 or 150 feet high; but in winter the surface of the sea is covered with ice, and there is hardly an open space to be found along the whole of the Siberian coast. In winter the ice is often more than 9 feet thick and the pressure of ice forms heaps of blocks piled up to a height of 60 or 70 feet. When the wind is fresh the falling snow causes fearful snowdrifts and snowstorms. During such snowstorms tongue-shaped crests are formed upon the surface of the snow running parallel with the direction of the predominating winds from west-north-west to east-south-east and thus serve as a compass to guide travellers. During hard frosts numerous chasms are formed in the ice through which water penetrates in spring and promotes the thawing and breaking up of the ice in an astonishing degree.

On the coast of Siberia the ice begins to break up at the end of June, but further out at sea it often lasts until the end of July. During the rest of the summer, however,

blocks of ice of various sizes, partly the remains of the winter covering of the sea, and partly carried down by the large Siberian rivers, are carried by the winds and the currents over the ocean and collect sometimes in one place and sometimes in another without having any regular egress to the southern waters. The pressure of water carried by the Gulfstream doubling Nova Zembla forms a contrary current in the Sea of Kara, carrying the ice of this sea through the Kara Straits and Waigach Sound and thus completely clearing it before the autumn. This enables ships to penetrate through Matochkin Shar, a narrow sound, separating the two islands of Nova Zembla, into the Sea of Kara, and, if it be clear of ice, to reach the gulf of Yenesseisk and make a return voyage the same autumn. This however is not always possible and ships cannot rely upon reaching and leaving the gulf of Yenessei the same autumn. The ice, covering the enormous expanse of ocean between the mouth of the Yenessei and Cape Dezhnev, has no other outlet than through some of the sounds of the unknown polar lands to the shores of Greenland, and then along this coast to the south. At all events this was the course taken by the ice upon which the crew of the lost American ship Jeanette accidentally left the things they had cast away and which were eventually found off the coast of Greenland. Naturally this circuitous route does not completely ensure the egress of the ice, formed off the Siberian shores, into more southern latitudes where it would be quite melted. For this reason the route through the Arctic Ocean from European seas to the mouth of the Lena and especially to the Behring Straits is by no means sure, and although Nordenskjöld's expedition on the Vega, for the first time in the history of navigation, penetrated through the ice of the Arctic Ocean from the seas of Europe to the Pacific Ocean, this can at present be only regarded as a stroke of luck, the difficulty of the undertaking being shown by the fact that through a few days delay on the road the Vega was still obliged to pass the winter on the coast of the Chukotsk Peninsula, and was only able to leave winter quarters and, doubling Cape Dezhnev, get out into the adjacent Behring Straits by the 20th of July of the following year. In the same way Dezhnev who discovered the sound dividing Siberia from America, called after him in 1647, was unable to double the Cape in that year and only succeeded in doing so in 1648.

There are not many islands along the Siberian coast to the east of the large double island of Nova Zembla. It is unnecessary to describe such islands as the White, Sibiriakov and Taimur, and likewise those formed by the deltas of the Lena, Yana and Indighirka, all of which are adjacent to the continent, but those which are further from the coast, like Wrangel's land and the group of New Siberia Islands, are quite worthy of mention.

Wrangel's land is an island quite uninvestigated by the Russians and only a little known by the American whalers. The Americans have doubled it from the north and shown that its dimensions do not exceed those of the New Siberian Islands, and from which it does not apparently differ in its physical conditions.

The New-Siberian group is well known to the Russians and consists of three large islands, Kotelnoi, Fadievskoi and New Siberia lying in the open sea to the north-east of the delta of the Lena, and a few smaller ones situated like Liakhov Island and others nearer to Cape Sviatoi. Further to the north beyond the islands of Nova Zembla, the American expedition of the lost Jeanette discovered some other small islands, but the three large

New Siberians are the only ones visited by Russian traders and inhabitants of the polar tundra zone. These islands are generally reached in spring before the thawing of the ocean ice, and the traders drive over the frozen surface of the sea on light sledges drawn by reindeer or dogs and, passing the short summer on the islands, return home in antumn when the ice has again set on the surface of the sea. The Siberian traders are generally drawn to these islands by the quantity of mammoth bones found there. The New Siberian Islands are of great importance from a scientific point of view as they form a vast and interesting cemetry of the whole organic world, as it at one time existed under 75° and 76° of north latitude. This organic world not only consisted of the large extinct animals like the mammoth, two varieties of the rhinoceros, buffalo, muskox, three varieties of deer and even a breed of horses, but also of the numerous trunks of extinct trees belonging to the middle tertiary, miocene formations, allied to the genus of deciduous trees peculiar to the temperate zone and not growing at present in any part of Siberia, like the elm and hazel.

The unusual abundance of skeletons and remains of extinct animals and plants in the New Siberian Islands is due to the conditions of the soil consisting of post-tertiary strata with intermittent layers of pure ice, spread over such an enormous area that if, for example, the temperature of the air upon the island of New Siberia rose for a prolonged period above zero, except the four mountains forming its framework, consisting of masses of granite that have abruptly raised the rocky strata of the jurassic formation, the whole island would become converted into a liquid paste, which together with the fossil remains included in it, would become the prey of the waves. At the present time the flora and fauna alike of the New Siberian islands are extremely meagre. In the whole summer passed during the years 1885 and 1886 by the members of the Academy Expedition, Doctor Bunge and Baron Toll, upon the New Siberian islands, there were but few days when it was possible to make any collections of flowering plants or live insects. One or two clear and comparatively warm days alternated with cold and cloudy weather, and the living vegetable covering again disappeared beneath a layer of snow. Upon the rocks of the lesser New Siberian islands, Stolbovoi and Liakhov, past which Nordenskjöld's expedition went in the second half of August, the weather being fine and the sea perfectly free from ice, comparatively few birds were nesting and the neighbouring sea shewed no traces of large marine animals.

But however unfavourable the climatic conditions of the Siberian littoral of the Arctic Ocean, it cannot be said that its depths are absolutely devoid of life. The deep ocean flora consists of seaweeds (algae), of which in the whole of the shore waters of the Arctic Ocean, thanks to the careful investigations of Nordenskjöld's expedition, 35 species were found, among them 16 belonging to the family of the fucoideae and 12 to that of the florideae. At the same time the seaweeds of the Siberian shore are far from attaining the luxuriant development and the vast dimensions which are as a rule proper to the algae of the polar seas. On the other hand seaweeds are almost entirely absent from the immediate coast zone of the Siberian sea. The marine flora attains its highest development at some distance from the shore in the sub-littoral zone, and only there in some few spots, as for example around the island of Taimyr are to be found localities rich in seaweeds.

The Siberian coast of the Arctic Ocean has no lack of marine animals. Of the lower animals, Nordenskjöld's expedition found near the mouth of the Kolyma cup-shaped sponges,

around the shores of the Taimyr peninsula and cape Cheliuskin, extremely beautiful forms of marine star-fish, antedon Eschrichtii J. Müll., and ophiacantha bidentata Retz, and near the winter quarters of the expedition, the star-fish (ophioglypha nodosa Lütaen). The Arctic Ocean is incomparably richer in species of molluscs and crustaceans. The species of the latter, as for example, idothea entomon L. and idothea Sabinei Kr., are met with in large quantities even where organic life in general is poor, as for example near the delta of the Lena. Further to the east and nearer to Behring Straits small crayfish (sabinea septemcarinata Seb.) and species of crabs (chionoecoetos opilis Kr.) are met with.

As regards vertebrates, the Arctic Ocean is fairly rich in different kinds of fish, ascending the full-streamed rivers of the ocean basin. The Siberian rivers possess a particularly large number of kinds of gwiniad (corregonus), among which are the nelma (corregonus leucichtis), peliad (corregonus peled), chir (corregonus nasutus), omul (corregonus omul), muksun (corregonus muksun), pechora gwiniad (corregonus polkur), et cetera. The dorse (gadus navaga Koerl.) and smelt (asmerus eperlanus) breed in considerable quantities in the Arctic Ocean. But special interest is attached to the black fish (dallia delicatissima Sm.) newly discovered by Nordenskjöld's expedition and possessing an exquisite taste, with which the Chukches have been acquainted from the earliest times. As for the marine mammals, they are of course the same as in all the polar seas, namely various kinds of seals (phoca barbata, hispida, cristata, leporina, groenlandica, foetida), the dolphin (delphinus leucas), the morse (trichecus rosmarus), the ork (phocaena orca), and finally whales, which while rarely approaching the Siberian shore waters are very frequent to the north of the oceanic islands, Wrangel Land and New Siberia. They however fall as booty not to the Siberians but to the American whalers, and indeed it may be said that the resources of the Arctic Ocean are little worked from the Siberian side.

CHAPTER V.

The Amour-Littoral Border Land.

Division into four regions; Transbaikal region; its contour, climatic conditions, flora, fauna and population; the Amour region, its orography, climate, vegetative covering, fauna and population; the Ussuri-Littoral region, its orography, hydrography, climate, fauna and flora; the island of Sakhalin; the population of the country; the Okhots-Kamchatka region, and its component parts; the Okhotsk shore, Kamchatka and the Chukot country; their orography, flora and fauna; scantiness of the population, and its disposition; the Okhotsk and Behring seas.

A FAR greater importance than is possessed by the above described regions belongs to the Amour-Littoral border land of Siberia, consisting from an administrative point of view of three territories, the Transbaikal, Amour and Littoral, forming together the Littoral Governor-Generalship. Geographically, the Amour-Littoral region occupies the whole Russian part of the Amour basin, the Transbaikal part of the Yenissei watershed, the whole Russian coast zone of the Japan Sea, the island of Sakhalin, the whole shore of the Okhotsk Sea up to the Stanovoi or Yablonovoi range, the whole peninsula of Kamchatka and the whole north-eastern extremity of the Asiatic continent, beyond the Yablonovoi range, with the river region of the Anadyr and the Chukotsk peninsula. The Amour-Littoral country thus extends over an area exceeding fifty-two thousand square geographical miles. This expanse is divided on account of its natural conditions into four sharply contrasted regions, the Transbaikal, Amour, Ussuri-Littoral and Okhotsk-Kamchatka.

The first of these, the Transbaikal country, coincides with the Transbaikal territory, and covers eleven thousand square geographical miles. It is intersected diagonally through the very centre by the Stanovoi range, which is the watershed between the waters flowing from its north-western side into Baikal Lake, namely the Selenga, Barguzin and Upper Angara, and into the Vitim, the right tributary of the Lena, and for the streams flowing from the south-east into the Shilka, one of the two upper rivers of the system of the Amour. In an offset of this range which nowhere attains the limit of eternal snow but serves to divide the longitudinal valleys of the Ingoda and Onon, component branches of the river Shilka, rises the highest mountain of the whole region, Chokondo 8,200 feet above sea level. Its summit is in the Alpine zone but nevertheless does not reach the snow line. The whole Transbaikal country with the exception of the steppe tract passing along the Chinese frontier between

the Onon and the Argun, the southern constituent of the Amour, is more or less mountainous. The prevailing trend of the mountain ridges of the Transbaikal country is from the south-west to the north-east. This direction is not only followed by the Yablonovoi range itself, but also by the ridge which is detached from the Khamar-Daban in the south-western corner of the territory and bounds the longitudinal valley occupied by Lake Baikal on the south-east, as also by the ridge above mentioned separating the longitudinal valleys of the Onon and Ingoda, and by the Nerchinsk range which serves as the watershed between the Shilka and the Argun as far as their confluence, and finally by the ridge accompanying the Shilka on its left bank. None of these mountains attain any great absolute altitude; the height of the passes of the Yablonovoi range between Verkhneudinsk and Chita does not exceed 3,400 feet, and the loftiest points, 4,000 feet. The Khamar-Daban offset contains mountains which reach 6,000 and even 6,700 feet. There is no lack of outcrops of rocky strata in this region; the majority of the mountain ridges exhibit crystalline rocks, granite, gneiss and mica schists. Here and there diorite is met with, as also true volcanic rocks such as trachyte and basalt. The stratified rocks, in their upheaved crystalline layers, disclose the presence of paleozoic formations, especially the silurian and carboniferous, and also secondary such as jurassic, and tertiary. Such a variety in the geological constitution of the Transbaikal country ensures mineral wealth of the first order. Here there are to be found not only gold bearing sands, argentiferous lead and copper ores, but also deposits of tin and mercury. There is no want of iron ores.

The Transbaikal is extremely rich in mineral springs. The country is well watered in spite of its continental situation. The Selenga and its tributaries, the Chikoi, Khilok, and Uda, as also the head streams of the Amour, the Ingoda, Onon, Shilka, and Argun, water beautiful valleys and plains, excellently adapted to cultivation and settled life. Not less well irrigated, but less fertile on account of the greater severity of the climate, are the valleys of Barguzinsk the most northern district in the Transbaikal territory, namely those of the Vitim, its tributary the Tsypa, of the Barguzin and the Upper Angara. In the Transbaikal country there are also plains although of not any great extent, as for example the tableland along the Uda known under the name of the Khorinsk and Bratsk steppes, and in the southern part of the territory near to the Chinese frontier, the Tareisk, Kydara and Argun steppes. At a rough estimate, more than a third of the area of the Transbaikal, or 4,000 square geographical miles may be referred to lands suitable for cultivation and permanent settlement.

The climatic conditions of the Transbaikal country differ widely from those of the other constituent parts of the region under consideration. The climate of Transbaikalia is purely continental. The mean annual temperature ($-2^3/_4{}^\circ$ Celsius), approaches the average temperature not of the cultivated or agricultural, but of the forest zone of Eastern Siberia. From its winter temperature (-25°) and that of the coldest month (-28°) the climate has a severer character than even in the said forest zone, but from the temperature in summer (17°) and during the hottest month (19°) Transbaikalia shews better conditions than the agricultural zone of Eastern Siberia. Thus, the difference between the winter and summer temperatures (42°) and between the hottest and coldest months (47°) indicates the highly continental character of the climate compared with that of Eastern Siberia. As for the mean temperature of the vegetative period, although it is $^1/_2{}^\circ$ below that of the cultivated zone of East-

ern Siberia, amounting to only 13°.5, yet the cereals, notwithstanding the constantly frozen soil in some places of this country at a depth of 1 1/3 arshine, ripen well, thanks to the more powerful action of the sun's rays, depending not only on the southerly situation of the Transbaikal but also on the cloudless and transparent atmosphere, as compared with the cultivated regions of Eastern and Western Siberia.

In reference to the amount of rainfall, the climate of Transbaikalia is also incomparably more continental than that of the agricultural zone of Eastern and Western Siberia. The quantity of moisture precipitated here in the course of the whole year does not exceed 290 millimetres, instead of the 360 and 380 of the agricultural zones of Eastern and Western Siberia, while the winters are almost entirely snowless, with 13 millimetres during the whole season. Fortunately, the summer rainfall, as much as 200 millimetres, is considerably higher not only than that in Eastern but than that in Western Siberia, and the conjunction of these conditions explains the fact that the Transbaikal country may even to-day be considered the chief granary of the whole Amour-Littoral region.

The vegetable covering of Transbaikalia reflects all the minutest features of its climatic peculiarities: in that half of the country which is situated between the north-west slope of the Yablonovoi range and the Baikal Lake, the flora still bears completely the character of the mountain flora of the extremity of the Altai-Sayan system. Among shrubs this flora includes rhododendra (rododendron chrysanthum Pall. et dahuricum Pall.), the Siberian berberry (berberis sibirica Pall.), species of meadow-sweet (spiraea trilobata L., alpina Pall., digitata W.), clothing the mountain steeps with their snow-white flowers, a species of tamarisk (myricaria davurica Ehr.), species of currant (ribes fragrans Pall., et procumbens Pall.). Alpine herbs, exclusively peculiar to the Altai-Sayan system grow in profusion in the Transbaikal; but on crossing to the other side of the Yablonovoi range the flora becomes greatly changed, and plants appear belonging to the far east of the temperate zone of the Asiatic continent. Thus, of the woody races, trees are here to be met with belonging to those generally thriving in Siberia from the very Ural, the oak (quercus mongolica Fisch.), the elm (ulmus campestris L. var. pumila L.), the hazel (corylus heterophylla Fisch.) and the wild apple (pyrus baccata L.).

It is remarkable that but few of the shrubs first appearing beyond Lake Baikal, as for example the daur blackthorn (rhamnus davurica Pall.), of the leguminosae lespedeza juncea Pers., one species of meadow-sweet (spiraea angustifolia Turcz.), one species of currant (ribes diacantha Pall.), the daur snow-ball tree (viburnum davuricum Pall.), a small shrub belonging to the spurge family (geblera suffruticosa Fisch.), and one of the low growing birches (betula fruticosa Pall.) belong to the Amour flora. The rest are peculiar to the so-called daur flora and common to the Transbaikal and the neighbouring Mongolia. There are two kinds of traveller's joy (clematis davurica Pall. et atragene macropetala Led.), one blackthorn (rhamnus erythro-xylon Pall.), among the leguminosae (lespedeza trichocarpa Pers. et hedysarum fruticosum L.), among the rosaceae, the local wild almond (amygdalus pedunculata Pall.), the wild apricot, widely spread on the mountain sides (prunus sibirica L.), a species of dog-rose (rosa alpina L.), a gattentree (cotoneaster acutifolia Lindl.), the shrubby potentilla glabra L., a species of tamarisk (myricaria longifolia Ehr.),

two species of currant (ribes triste Pall. and pulchellum Turcz.), honey-suckle (lonicera chrysantha Turcz.), two species of shrubby birch (betula divaricata Led. and Gmelini Bge.) and the willows (salix berberifolia Pers. et divaricata Pall.), the remaining willows found here belonging to the European kinds.

To the kinds disseminated over the whole of Siberia belong not only all the coniferous trees of Transbaikalia, namely, the pine (pinus sylvestris L.), the Siberian and daur larches (larix sibirica Led. and davurica Fisch.), the Siberian fir (abies sibirica Led.), the Siberian pitch pine (picea orientalis L.) and the cedar (pinus cembra L.), but also many of the deciduous trees, the white and daur birches (betula alba L. and davurica), the aspen (populus tremula L.), et cetera. The fine-scented poplar (poplus suaveolens Fisch.) is met with on both sides of Lake Baikal.

As for the herbaceous flora, of 112 species of them, first met with beyond Baikal, only 46 pass over to the Amour, the rest belonging to the local so-called daur flora, which serves as the connecting link between Siberia and Mongolia, whither indeed many plants cross over. Among the latter are, for example, of the crow's foot family (ranunculaceae) two species of hellebore (eranthis sibirica Dc. and uncinnata Turcz.) and actinospora davurica Turcz.; 5 cruciferae draba, mongolica Turcz., tetrapoma barbareaefolium Turcz., dontostamon eglandulosus Led. and oblongifolius Led.; of the leguminosae 10 species of oxytropis (a genus characteristic of the mountain steppes of Central Asia, entirely unknown on the Amour), two astragals; of the rose family (chamaerhodos grandiflora Led. and trifida Led.); of the stonecrops, (saxifraga multiflora Led.); 6 umbelliferae, 6 compositae; of the corolliflorae, pinguicula spathulata Led.; three species of bindweeds (ipomea sibirica Pers., calystegia pellita Led. and calystegia subvolubilis Led.); 4 borragineae, 3 scrophularieae, 3 labiateae and 3 species of statice characteristic of the salt steppe; of the family of monochlamydae, two species of rhubarb (rheum undulatum L. et campestre L.), one of sorrel (rumex Gmelini Turcz.), passerina Stelleri Wickstr. and a spurge (euphorbia Pallasii Turcz.); of the monocotyledons, sparganium longifolium Turcz.; two orchids (orchis salina Turcz. gymnadenia pauciflora Lindl.), iris ventricosa Pall., pardanthus dichotomus Led., polygonatum sibiricum Led., two sedges and two grasses.

Corresponding to the striking change in the vegetable covering of the Transbaikal country is that of the fauna of the invertebrates. Very many of their forms, entirely absent from Siberia, as for example among the articulate animals the river crayfish, appear upon the upper streams of the Amour system, of course with specific distinctions from the European (astacus amourensis). The approach to the sea makes itself felt in the appearance of such forms of insects also as serve as transitional forms from the continental to the littoral. Thus, for example, in the genus carabus of the family of the coleoptera, not possessing true wings under their brilliant elytra, the local elongated, comparatively narrow forms of the subgenus coptolabrus (species coptolabrus smaragdinus Fisch), serve as the transition to the still more elongated forms of the Japanese subgenus of carabs damaster.

As regards the vertebrate fauna, with the more extensive regions of distribution of these animals, the Transbaikal fauna naturally shews incomparably more resemblance to the remaining fauna of Siberia. Nevertheless, to the animals occurring over the whole forest zone

of Eastern Siberia (v. supra), are added a few mountain forms of the Altai-Sayan system, steppe forms of Mongolia, and finally, animals breeding in the Amour Territory and in Manchuria. To the first belong, the musk deer (moschus moschiferus L.), roebuck (cervus capreolus L.), badger (meles taxus Schr.), polecat (mustela putorius L.), Eversmann's marmot (spermophilus Eversmanni Br.) and the rat hare (lágomys alpinus Pall.). To the second belong, the korsak (canis corsac L.), steppe cat (felis manul Pall.), baibak (arctomys bobac Schr.), lagomys ogotona Pall., the jerboa (dipus jaculus Pall.), tolai (lepus tolai Pall.), two species of saiga (antilope gutturosa Pall., antilope crispa Temm.) and finally, the kulan or dzhigetai (equus hemionus Pall.). To the third belongs the Amour raccoon (canis procyonoides Gr.), a species of dur (cervus elaphus L.) and wild boar (sus scropha L.).

The fauna of the birds which from the very nature of their mode of locomotion are capable of having the most extensive region of distribution, also here includes both northern and southern forms. To the first, for example, belong the capercailzie (tetrao urogallus L.), blackcock (tetras tetrix L.), hazel-hen (tetrao bonasia L.), white and alpine ptarmigan (lagopus albus Gm. and alpinus Nilss.); to the second, the steppe blackcock (syrrhaptes paradoxus Pall.), black crane (grus monachus Tem.), and two more southern species of crane (grus leucogrammus Pall. and grus virgo L.), the blue magpie (pica cyanea Pall.), et cetera.

In regard to snakes and other reptiles, on the whole occurring so rarely in northern Siberia, the Transbaikal country is comparatively rich. Besides the harmless snake (coluber rufodorsatus Cant.) and elaphis dione Pall., there are here to be met with the extremely venomous varieties, trigonocephalus intermedius Strauch and trigonocephalus Blomhoffii Boje. Finally the piscino fauna on crossing the Yablonovoi range into the system of the Amour completely alters its character (v. infra).

Thanks to comparatively favourable climatic conditions and the early colonization, which began here already from the end of the XVII century (in 1692 there were already 7,000 Russians, in 1720, 10,000, in 1740, 20,000 and in 1760, 40,000) the Transbaikal territory has now as many as 570,000 inhabitants, that is, above five souls to the square geographical mile, of whom the natives, mainly Buriats and to a small extent Tungus, count 170,000 or about 30 per cent of the total population. These Buriats of Mongol race and Buddhist faith, nomads within narrow limits, have here preserved, in the immediate neighbourhood and communication with Mongolia, their national characters in a greater degree than in the government of Irkutsk. They are here occupied chiefly in cattle rearing, while agriculture occupies the first place among the Russian population. The proportion of the town population in the Transbaikal country is insignificant; it does not exceed five per cent; indeed there are no collections at all considerable of town population except in Chita whose inhabitants have now attained 13,000 souls.

The preponderance of the rural over town industries is sufficiently indicated by the relation of the numbers of the population to the domestic animals reared. There are here 70 horses per 100 inhabitants, with an absolute number of 400,000 head, that is, as many in proportion as in Eastern Siberia. As for the relative number of horned and other cattle, the Transbaikal is in this respect in the most favourable conditions compared with early colonized Siberia. There are here over 100 head of horned cattle per 100 inhabitants, the absolute number being

570,000, that is, 5 head per married couple, while of other cattle there are 350 head per 100' inhabitants, the absolute number being as many as 2,000,000, which directly demonstrates the high proportion among the population of the cattle breeding class, and the wealth of pastures possessed by the country.

The Amour Country.

This country, the second part of the Amour-Littoral region, presents in all its physical conditions a type absolutely different from that of Transbaikalia. By the Amour country is understood all the vast area occupied by the basin of the Amour along its left bank from the confluence of the Shilka with the Argun to the Stanovoi range and the Dzhugdyr ridge, dividing the Amour basin from that of the river Uda. Thus into the country of the Amour enters the whole Amour territory and the expanse between the eastern frontier running along the meridian and the course of the Amour to its mouth. In this way the Amour country occupies, just as Transbaikalia, not less than 11,000 square geographical miles.

Mention has been already made above of the Stanovoi or Yablonovoi range, serving for a long distance as the northern boundary of the country, as this range separates the Yakutsk and Amour-Littoral regions of Siberia. But independent of this range, descending less abruptly into the Amour territory than into that of Yakutsk, a considerable part of the country is mountainous and filled with the spurs of the Stanovoi range and by such offsets as, like the Little Khingan or Burein range, have an almost meridional direction and fling back the Amour by their prolongations, forcing it to take a wide curve to the south. The connecting link between the Little Khingan and the Stanovoi range is the Dzhugdyr ridge, forming the watershed between the basins of the Amour and the Uda, falling into the sea of Okhotsk in the Littoral Territory. The Little Khingan, with an average altitude of 2,500 feet reaches as much as 4,000 and even 6,000 feet at its summits near the head waters of the Bureya. The crest of the Khingan and especially its peaks are formed of «golets» sprinkled on their slopes with stone heaps. The rocks prevailing in the mountain ridge are crystalline and consist mainly of granites which are also discovered on the Amour, where the mountains approaching the bed of the river nowhere rise higher than 1,000 feet above the level of the river. Upon the mountain slopes of the Stanovoi range and the Little Khingan and their offshoots are developed stratified rocks of paleozoic formations, especially the devonian, upon the southern incline of the Stanovoi range; secondary, namely, jurassic, upon the lower reaches of the Oldoi and Zeya and upon the upper waters of the Bureya, and finally tertiary along the Amour, Zeya and Bureya.

The country is abundantly watered. Its chief stream the Amour is one of the three colossal rivers of Asia falling into the Pacific. Its length, counting the rivers Argun and Kerulen as its head waters, amounts to not less than 4,600 versts. Having described its great arc, whose southern part crossed 48° N. lat., and having embraced with this arc on the south the whole Russian region of the Amour, it turns to the north-east and after reaching 51·5° N. lat., approaches so closely to the part of the Tartar strait, forming the northern extremity

of the Sea of Japan, that Lake Kizi, a lateral enlargement of the bed of the Amour on the right side is only separated by a twelve-verst isthmus from the Tartar strait, a little to the north of the beautiful bay of De Kastri. Here meeting with an impossible barrier to its exit towards the sea, the Amour swerves to the north, and only about 53° N. lat. finally turns to the sea and falls into that part of the Tartar strait which forms a part of the cold and inhospitable Sea of Okhotsk. The left tributaries of the Amour, the Zeya and Selimdzheya, the Bureya and the Argun are after the Amour the chief arteries of the Amour country. It is only in the lower reaches of these streams that more or less extensive plains spread out on either side; nearest the Stanovoi range and the Little Khingan the region is mountainous.

The climate of the Amour country, although still continental, is yet characterized by a greater humidity than in original Siberia. In Blagoveschensk the mean annual temparature is —1.3° Celsius, but the mean winter temperature is — 24°, that of the coldest month —27°, that of summer 19° and that of the hottest month 21°. This yields a difference between summer and winter temperatures of 43°, and between the hottest and coldest months of 48°, almost the same as in Transbaikalia. But the mean temperature of the five-months vegetative period, 15°·6, is still more favourable than in the Transbaikal country, and perfectly admits of the free development of agriculture, while upon the lower reaches of the Amour, in Nikolaevsk, where the average temperature of the year is —2·6°, the temperature of the winter —22°, that of summer 15° and the climate is less continental, with differences of 37° and 40°, the free development of agriculture is very difficult, as the mean temperature of the five-months vegetative period only amounts to 11·6°.

In the quantity of the annual rain, over 500 millimetres, of which 290 fall during the three summer months, the Amour country has not only a more humid climate than Transbaikalia with 290, and the agricultural zones of Eastern and Western Siberia, 360 and 380 respectively, but even more than their forest zones which have 400 and 470 millimetres. The excess of moisture in the Amour country exercises an unfavourable influence upon agriculture, which is still further intensified by the character of the vegetable covering of the region. All the lower slopes of the mountain ridges and their offsets are overgrown with weeds, and the upper declivities with trees which so powerfully arrest the moisture that the soil does not dry up. In consequence of this the greater part of the area is covered with unbroken swamps and forests, above which rise only the denuded «golets» of the rocky crests covered with stony talus upon their slopes. Cereals sown upon clearings run to straw reaching an incredible height, but frequently yield a poor grain sometimes not ripening completely. An exception to this is shewn by a few spots situated partly along the Amour in places not drowned by its inundations, partly near the lower course of the Zeya. There are at present few such spots suitable for agriculture, and of its area of 11,000 square geographical miles not more than 2,000 can as yet be recognized as fit for agricultural settlement.

Fortunately, experience has shewn that the struggle with the excess of moisture which is an impediment to the cultivation and colonization of the Amour, which is to-day in the position of Germany in the days of Tacitus, is possible. The settlers in the Amour territory blaze over large areas the growths of reeds, the damp soil gradually dries and becomes converted into fertile arable land. In the course of 38 years, which had expired between the geograph-

ical and botanical explorations of the academicians Maximov (1854) and Korzhinsky (1892), the climatic conditions of the country have already manifestly changed for the better and the gradual progress of the country, exceeding Germany in extent, in the sense of its gradual passage from the condition of the Germany of Tacitus to its present state, has already begun. But of course much time will still pass, before Russian colonization, now capable of occupying not more than one-fifth of the country, wrests step by step from a stern nature even half of the area for cultivation and civilization, and so far, without the spots which are accessible to cultivation and colonization, the Amour country, in the mountainous region of which there is still much gold to be found, is condemned only to sporadic and partly rapacious cultivation.

The vegetative covering of the Amour country is luxuriant and peculiar, and displays a great difference from the floras of the other parts of Siberia. Even the woody vegetation exhibits striking differences from the similar vegetation of not only Siberia but also Transbaikalia. With the ordinary Siberian races of conifers are here associated the Manchurian cedar (pinus mandshurica Rupr.), the ayan pitch-pine (picea ajanensis Fisch.) and an ally of the conifers, the yew (taxus baccata L.) peculiar to the mountains of the Caucasus. The yew nowhere else is to be met with in Siberia, and shews by its appearance on the lower Amour the nearness of the sea. The flora of the foliage trees and shrubs is both richer and more varied, here going to meet the beneficent marine influences of the Eastern Ocean. The lime genus is here represented by two peculiarly eastern forms, tilia cordata Mill. and tilia mandshurica Rupr. et Max. The maple, a stranger to the whole of Siberia, has here four representatives, of which the acer mono Max. is the characteristic local kind, the acer ginnala Max., a species closely allied to the eastern European acer tataricum L. and the Semirechensk acer Semenowii Reg.; the acer tegmentosum Maxim. bears a resemblance to the American kind (acer pensylvanicum L.); finally, the acer spicatum Lam. is undoubtedly an American variety. The apple, already appearing in Transbaikalia in the shape of a very small fruited variety (pyrus baccata), is here represented by a beautiful new species (pyrus ussuriensis Max.), and the bird cherry by two local varieties, (prunus Maackii Rupr. et Maximowiczii Rupr.). Two local species of walnut embellish the forests of the Amour, juglans mandshurica Max. and juglans stenocarpa Max., as also the local species of the ash unknown to the whole of Siberia, fraxinus mandshurica Rupr. With the European and Transbaikal varieties of the elm is associated the local ulmus montana Winckl. Further alongside the species of hazel already appearing in Transbaikalia, corylus heterophylla Fisch., is found a new species, corylus mandshurica Max. Finally, among the birches reappear a Kamchatka variety (betula Ermanni Cham.) and one local timber tree (betula costata Trautv.). The third local variety of birch, (betula Middendorfii Trautv.) is a shrub. The charming little tree of the Amour country with a palmy crown, (dimorphantus mandshuricus Rupr.) is far removed from the character of the Siberian trees. It belongs to the family of araliaceæ which loves a moist climate and is nowhere to be met with in Siberia. Not less remarkable is the cork tree of this country (phellodendron amurense Rupr.), belonging to the family of zanthoxyleæ nowhere to be met with in the whole of Russia.

The shrubs of the Amour country are still more peculiar than the trees. Not less than 24 varieties of shrubs here met with are entirely new for any one arriving from Siberia

and Transbaikalia. Of these, three climbers are the lianas of the woods here. They are first of all, a beautiful plant belonging to the rare family of schizandraceae with pale rose-scented flowers and red berries, (maximoviczia chinensis Rupr.), spread from northern China through Manchuria to the Amour country; a species of vine, very slightly distinguished from the true vine (vitis amurensis Rupr.); and finally the wild vine (cissus brevipedunculata Max.). The species of clematis appearing here for the first time, clematis mandshurica Rupr. and aethusaefolia Turcz., belong to the non-climbing shrubby varieties of this genus. Of the two species of local berberry one is also peculiar to northern China (berberis sinensis Desf.); another, local (berberis amurensis). The very curious shrub of the Amour country, actinidia kolomikta Rupr., covered with large white scented flowers, has not yet found a strictly definite position in systematic botany, it being now referred to one now to another of the exotic families. Of the four local varieties of spindle-tree there is one Japanese (evonymus alatus Th.) and three local (evonymus pauciflorus Max., evonymus Maackii Rupr. and evonymus macropterus Rupr.). Of the leguminosae the small shrub found here lespedeza stipulacea Max., also grows in the environs of Pekin. Of the rose family, the local species of cherry (prunus glandulifolia Rupr. and meadowsweet (spiraea amurensis Max.) are shrubs. Two local species, belonging to the same genus as our so-called garden jasmine (philadelphus) are a conspicuous adornment of the forests, philadelphus tenuifolius Rupr. and philadelphus Schrenkii Rupr. The beautiful local shrub of the same family Deutzia parviflora Bge. is a Chinese plant, spread by cultivation. To the family of araliaceae not to be met with in Siberia belong two shrubs common to this flora and that of northern China (panax sessiliflorum Rupr. and eleutherococcus senticosus Max). Of the honeysuckles there are here one chinese species (lonicera chrysantha Turcz.) and two local (lonicera Maackii Rupr. and lonicera Maximowiczii Rupr.). Common to northern China is a species of lilac occurring here on the skirts of the woods with somewhat minute whitish flowers (syringa amurensis Rupr.). A vaiety of laurel, met with on the lower Amour is that called after Kamchatka (daphne kamtchatica Max.).

Among the herbs of the Amour country, not less than 110 species are exclusively peculiar to this region, the rest are common to the Amour with China, Japan, Kamchatka and even America, but especially with Transbaikalià and Siberia. The whole flora of the Amour has 340 plants common with that of European Russia, that is, 38 per cent, while with Transbaikalia it has 527, or more than 58 per cent.

Equally peculiar with the flora of the Amour country is its invertebrate fauna and particularly the insects which are dependent on the same climatic conditions as the plants. Not less than 60 per cent of all the species of insects occurring in the Amour country are unknown to Europe, although the general character of the fauna is palearctic, that is, proper to the whole sub-polar and temperate zones of the Old World.

As for the vertebrata, in Amouria associated with the mammals occurring in the forest zone of Siberia are not only those animals which were mentioned in the survey of the fauna of Transbaikalia, but also some others. There belong the maral (cervus elaphus L.), whose horns are so highly prized by the Chinese, the tiger (felis tigris L.), the irbis (felis irbis Pall.), the mountain wolf (canis alpinus Pall.) and the thibetan bear (ursus tibetanus). The fish of the Amour country are in the highest degree interesting, the river and its trib-

utaries being extraordinarily rich in them. Of the sturgeon family, the local species of bieluga attains enormous dimensions (huso orientalis Pall. and amurensis Pall.), weighing sometimes from 30 to 50 pouds. The sturgeon of this region (sturio Schrenkii Br.) likewise differs from the Russian type, but the sterlet belongs to the Caspian species (acipencer ruthenus L.). Two species of salmon which ascend the Amour and Ussuri, to the present day in countless numbers, have a great significance for the country, the gorbusha (trutta proteus Pall.) and ket (trutta lagocephalus Pall.). Of the other fish common to Siberia are the delicious taimen (salmo fluviatilis Pall.), the char (salmo coregonoides Pall.), the smelt (salmo eperlanus), the carp (cyprinus carpis) and eelpout (lota vulgaris Cus.). But there are also a few fish which are extremely characteristic of the Amour basin. Among these are to be reckoned the Amour fish (pristidion Semenovii Dyb.), the daur silarus (silurus asotus Pall.), the barbodon locustris L., plagiograthus Yelskii Dyb., the white fish (culter abramoides Dyb.), the verkhogliadka (cutter Sieboldi Dyb.), the verkhobriushka (culter lucidus Dyb.) and the local variety of pike (esox Reicherti Dyb.), the latter attaining an enormous size.

The population of the Amour country consists of only 90,000 inhabitants of both sexes, among whom are 3,000 wandering natives. The majority of these natives (Orochons, Mangountsi, Birars) belong to the Tunguz tribes, and only the minority to the Ghiliaks, who have nothing do with them ethnographically, and speak a language of their own. The latter are more numerous only on the Amour frith and on the seacoast of the Littoral territory, as also on the island of Sakhalin. The Ghiliaks together with the Ainos, Kurils and ancient aborigenes of Kamchatka belong to a special coast tribe which once occupied the whole shore of the Eastern Ocean inclusive of the Japanese islands, at least the northern islands, the Kuril line and the peninsula of Kamchatka. They were driven out from their places of abode on the Japanese series of islands by the Japanese, and on the coast by the Manchurian tribes.

The Ghiliaks are principally fishermen and are engaged in sea industries, while among the Manchurian tribes, as ancient cattle breeders, the polar form of this occupation, the rearing of reindeer, is in a state of more or less equilibrium with trapping and fishing. Much more numerous than these weak and it may be said dying-out tribes of Tunguz in the Amour country is the settled agricultural Tunguz tribe of Manchurians. These Manchurians, now numbering 14,000, occupied in the times preceding the Russian dominion an excellent area for colonization, upon the left bank of the Amour, opposite the Chinese town of Aigun and by the terms of the Aigun and Pekin treaties remain established upon Russian territory, but upon their own lands, as Chinese subjects, and are occupied mainly with agriculture. To this settled native population must be added further about 1,000 Coreas now established in the country.

Russian immigrants still form 80 per cent of the population of the country. They have settled in more or less considerable villages along the whole course of the Amour with the exception of those portions adjacent to its banks where constant inundations impede the settled and agricultural mode of life of the Russian colonies, as also upon the extensive and excellent area for purposes of colonization stretching along both sides of the lower reaches of the Zeya and its lower tributaries. Another area adapted to colonization is moving gradually into the heart of the country, along the river Bureya and the neighbouring minor

tributaries of the Amour, and may in time occupy the whole space between the curve of the Amour and the Vanda tableland, which extends in the direction of the chord of the arc formed by the Amour, between the mouth of the Bureya and the Khabarovka. In the few and scantily populated towns of Amouria, among which Blagoveshchensk alone has 9,000 inhabitants, lives a little more than 11 per cent of its population, which clearly shews the predominance in the country of the rural population and of rural industries. The development of the latter is also demonstrated by the number of domestic animals in the country, although this number is comparatively lower than in the neighbouring Transbaikalia. Thus, in the Amour country there are 55 horses per 100 inhabitants (instead of 70), that is, a little more than in Western Siberia. Horned cattle give 70 head (instead of 100), but still more than in Western Siberia, and almost as many as in Eastern Siberia. Only the number of sheep and goats is as yet insignificant, 30 head per 100 inhabitants, instead of 380 as in the Transbaikal country. This is explained not merely by the recent settlement of the region but by the absence of a cattle breeding population.

The Ussuri-Littoral Tract.

The third type in the Amour-Littoral region is the Ussuri-Littoral tract, occupying the whole southern portion of the Littoral Territory, lying on the right side of the Amour, between its right tributary, the Ussuri, and the Sea of Japan. Including in the Ussuri country the island of Sakhalin lying opposite it in the Sea of Japan, an expanse of 7,000 square geographical miles is obtained. The greater part of this space is occupied by the right sides of the basins of the Ussuri and of the lower part of the course of the Amour from its confluence with the Ussuri. The long but low and very wooded range of Sikhete-Alin, stretching more or less parallel to the coast line of the Japanese Sea, separates a narrow shore land from the basin of the Ussuri, which has not sufficient room for the formation of any considerable rivers, excepting the southern part of it turned directly to the south, which has both deeply indented bays with fine harbours and a few tributaries of more importance than in the coast zone, as for example the river Suifun. The whole of the extensive hollow turned to the south of the coast line of this part of the littoral of the Ussuri country has received the name of the Bay of Peter the Great. Upon the peninsula, separating the Amour and Ussuri bays penetrating deep into the Continent, somewhat to the south of 43° north latitude is situated the town and port of Vladivostok, from which a railway is now being carried through the Ussuri country to Khabarovka, situated at the junction of the Ussuri and the Amour upon the right bank of the latter, the residence of the Governor-General of the three territories constituting the whole of the Amour-Littoral region of Siberia.

The height of the Sikhete-Alin is inconsiderable; in the case of the passes it amounts to from 1,270 to 2,370 feet, and in that of the highest of the mountain peaks yet measured, Mount Camel (Khuntami), it reaches 3,600 feet. In the crest of the Sikhete-Alin crystalline rocks such as granite are laid bare, and in its northern part which throws the lower course of the Amour back from De Castri Bay to the north, volcanic rocks such as trachyte and

basalt are to be met with. At the contact of the crystalline with the stratified rocks in the Sikhete-Alin, argentiferous lead deposits occur, and twenty versts from St. Olga Bay, rich deposits of iron ores. The eastern slope of the Sikhete-Alin, in its offspurs, sometimes descends in sheer precipices into the sea, and at others, leaves a certain space for the streams running along short parallel valleys to fall into the sea. In the neighbourhood of their mouths there are at times very convenient bays and bights, as for example, the bays of St. Olga and St. Vladimir in the southern part of the country and of De Kastri in the northern part. Upon the wide space dividing the Sikhete-Alin from the course of the Ussuri, run the important right tributaries of this river; in the south-western corner of this country the Russian possessions cross over to the left side of the Ussuri and embrace the extensive lake Khanka. The whole of this expanse includes the areas of colonization belonging to the country, which are only embarrassed by the abundance of swamps and forests and the extraordinary humidity of the climate.

The seashore range of the Sikhete-Alin, in spite of its slight elevation, serves however as an extremely important climatic line of division. The coast zone, situated upon the eastern acclivity of the Sikhete-Alin, wrapped for the greater part of the year in impenetrable fogs, differs extremely from the wide Ussuri zone, incomparably more continental in its climate, whose more favourable climatic conditions are also extended to the seacoast strip of the southward trending Bay of Peter the Great. This difference comes out most clearly on comparing the climates of points placed at no great distances from each other, Vladivostok, situated in the depths of the Bay of Peter the Great, and the Bay of St. Olga, situated 200 versts behind the cape which forms the turning point, separating the southern littoral of the country from the south-eastern, upon the foggy and damp south-eastern shore. The mean temperature for the year in both points, differing in latitude by only $^1/_2$°, is the same, namely 4·5°, but in the Bay of St. Olga the mean winter temperature is —10° Celsius, that of the coldest month —13°, the summer temperature 18°, that of the hottest month 20°; accordingly, the difference between summer and winter is 28°, that between the hottest and coldest months 33°; while the mean winter temperature in Vladivostok is —12°, that of the coldest month —16°, the summer temperature 18°, that of the hottest month 21°; accordingly, the difference between summer and winter is 30°, between the hottest and coldest months 37°, so that the climate of Vladivostok is more continental than marine. In Khabarovka the mean annual temperature is of course lower than in Vladivostok and in the Bay of St. Olga, it is equal to 0°, but the remaining elements of the climate are favourable, notwithstanding the severity of the winters. With an average winter temperature of —22° and coldest month of —25°, the summer shews 19°, the hottest month 20°; the difference between summer and winter is 41°, and that between the hottest and coldest months 45°. As might be expected, the mean temperature of the five-months vegetative period throughout the Ussuri country, in the Bay of St. Olga 15°, in Vladivostok 16°, and in Khabarovka 17°, is distinctly favourable to agriculture, but the climatic discrepancy between the two points shews itself most strongly in the quantity of moisture precipitated in the course of the year. In Vladivostok the annual rain fall is 336 millimetres, of which 158 belong to the three summer months, while in the Bay of St. Olga it is 1,024 millimetres, of which 452 millimetres fall to the summer months. Thus,

compared with the Bay of St. Olga, which represents the type of the most humid marine climate, the climate of Vladivostok appears to be far more continental, indeed even more so than that of Khabarovka, where 560 millimetres of moisture is precipitated in the course of the year, of which 312 falls during the summer months. Under such comparatively excellent climatic conditions, the port of Vladivostok remains open and accessible at almost all seasons of the year, with the exception only of an extremely short winter period, lasting here as in Odessa not more than $1^1/_2$ to 2 months.

Further, upon the western slope of the Sikhete-Alin, in the broad zone, covered to a considerable extent with woods and morasses, between the coast range and the river Ussuri, the climate is far moister than in Vladivostok and in particular is more rainy in summer. The humidity of the climate and the dampness of the soil, which never dries up owing to the dense vegetation, have determined the method of sowing grain in rows or beds, to allow the free passage of streams of air to prevent the rotting of the crop at the root. But however this may be, it has become evident that certain localities of the country are so damp that in them such a development of sporiferous plants or microfungi takes places on the ears that bread baked from the flour of grain stricken with these blights becomes intoxicating, producing in fact such symptoms in those who eat it. This inconvenience called forth by climatic conditions sometimes even causes immigrants to abandon the «spots which produce intoxicating bread».

Absolutely different and far less favourable are the conditions (as far as agriculture is concerned, as a consequence of its geographical situation), of the island of Sakhalin, which has acquired latterly a world-wide notoriety as a Russian convict settlement. This island, severed from the Ussuri country by the most northern part of the Sea of Japan, the Tartar or Nevelsky's straits, stretches exactly along the 8 dergees of latitude, between 54° and 46°, and projects with its northern extremity, Cape St. Elisabeth, into the Sea of Okhotsk, and with its southern extremity, bending round the extensive bay of Aniva in the shape of a horseshoe, approaches Japan, from which it is separated by the straits of Laperouse. Somewhat to the north of the bay of De Castri, the straits dividing Sakhalin from the Ussuri country are so narrow and shallow that they are inaccessible to large ocean-going ships, and in consequence rather separate than unite the mouth of the Amour with the Sea of Japan. The skeleton of Sakhalin is formed of a fairly elevated range with steep summits, consisting of volcanic rocks, such as basalt, which have lifted beds of stratified rocks belonging to the rare, in Siberia, cretaceous formation. It is here rich in shells, ammonites of great size, inoceramus, patella, rhynchonella et cetera. There also occur layers of middle tertiary or miocene formation, in which many remains of vegetation are to be met with, consisting of the leaves of the beech (fagus), walnut (juglans), and salisburia, now no longer thriving in Sakhalin. To the north of parallel 52° the Sakhalin range, attaining in its loftiest points (Three Brothers, on the northern extremity of the island and Engys-Pal, somewhat north of 52° N. lat.) 2,000 feet upon sea level, falls abruptly on the eastern side to the Sea of Okhotsk, and on the west, on the side of the Tartar straits, forms a low and marshy coast land between its foothills and the shore line. To the south of 52° the range is cleft into two crests by a longitudinal valley, along which from their junction run in the line of the meridian in opposite directions the

two principal streams of the island, the Tym and the Poronai. The extremity of the eastern ridge, attaining in Mount Tiara a height of 3,000 feet, declining a little from the meridian line to the south-east, beyond the mouth of the Poronai, forms the broad Bay of Patience. The western crest as far as the very extremity of the island falls abruptly into the Sea of Japan, rising above it to 3,000 and even 4,000 feet, and does not present on this side any convenient harbours, but exhibits near Due splendid deposits of coal. These coal fields, as also the petroleum springs discovered recently in Sakhalin, together with the fine fisheries of the Bay of Aniva, the bottom of which is luxuriantly covered with weeds going by the name of sea-cabbage, promise an economical future to this otherwise inhospitable island.

In what unfavourable climatic conditions, notwithstanding a comparatively not very northerly situation, the island of Sakhalin is placed, thanks to the current flowing down from the bleak Okhotsk Sea along the eastern littoral, bringing with it huge masses of ice, is evident from the following data. The mean temperature in the principal settlement of the island, Due, about 51° north latitude upon the western and warmer coast, is 0.5°, the winter temperature — 15°, that of the coldest month — 16°, of summer + 14°, of the hottest month 16.5°. Moreover the mean temperature of the five-months vegetative period, less than 12°, is insufficient for the development here of permanent agriculture. Little better is the climate in the Muraviov post lying 4° further south in the extreme south-eastern corner of the island. Here, it is true, the mean annual temperature is higher, 2.3°, the winter more moderate; the mean temperature is — 11°, coldest month — 12°; but on the other hand the summer is colder, the mean summer temperature being — 13°, that of the hottest month + 16°, so that the average temperature of the five-months vegetative period, less than 12°, is equally unfavourable to the raising of grain. This is explained by the circumstance that the eastern coast of Sakhalin, along which polar glacial currents descend to the south is in summer considerably colder than the western. As for the rainfall, it is much less considerable on the western littoral of Sakhalin than on the Bay of St. Olga, and amounts during the year to a little more than 500 millimetres, of which only 184 fall to the three summer months, while the autumns are almost as rainy as the summer. In a word, Sakhalin is unfit for agricultural colonization. Equally unfit is the whole northern half of the Sikhete-Alin and the corresponding part of the littoral, so that there can hardly be found more than 3,000 square geographical miles as an area for colonization in the whole Ussuri-Littoral country, after deduction is made of the too swampy and too damp spots, which so severely hamper the development of colonization in the Ussuri zone.

In the vegetable growth of the Ussuri country little difference is observable from that of the Amour. The greater part of the characteristic plants of Amouria cross over into Ussuria. It is however noteworthy that the proportion of European Russian forms is higher in the Ussuri country than in the Amour, namely 47 instead of 38 per cent, which is a direct indication of the less continental nature of the climate. The species of trees are identical with those in the Amour country. Only one new tree appears, a hard-beam (carpinus cordata Bl.) and two shrubs, the wild vine crossing from North China (cissus humulifolia Bge.) and the common European berberry (berberis vulgaris L.). Only a little over 80 species of herbaceous plants are found in the Ussuri Country, and not met with in Amouria, among them being species common to North China, Japan and America. Only 17 local plants

are known which have been found nowhere except in Ussuria. Among them is the celebrated ginseng (panax ginseng Reg.), whose root is so prized as a remedy by the Chinese. Probably many of these plants will be subsequently found in the Amour Country also, but some of them bear undoubtedly a more southern character. To the latter are to be referred, from the pea family, the beautiful climbing glycine ussuriensis Reg., of the exotic family pontederiaceae, the very showy marsh plant (monochoria Korsakavii Reg.); of the family of eriocaulaceae, eriocanlon ussuriense; finally, of the ferns, with a subtropical appearance, pleopeltis ussuriensis Reg. The flora of the Ussuri country has many forms common to North America; 25 per cent of the whole Ussuri flora is met with in North America, but of course the majority of these species belong to those equally existent over the whole northern zone alike of the Old and the New World, and only 32 species, entirely foreign to European Russia, cross from America, 14 through the Yakutsk region and 18 direct.

Almost the same may be said in reference to the invertebrate fauna, and especially of the insects, as to the flora. The majority of the species here are met with also in the Amour country, while the proportion of peculiar forms is very high, but approaching the Sea of Japan on the one hand a few forms appear not found in the Amour Country and bearing a subtropical character, and on the other, the proportion increases of purely European species or their analogues, a fact particularly noticeable in those orders of insects possessing a highly developed power of flight, as for example the butterflies and moths (lepidoptera). On the whole, both the flora and the fauna of the Ussuri country as also of the whole Amour-Littoral region bears a completely palearctic character, that is, the character of the northern zone of the Old World, here reaching right as far as the Eastern Ocean, while in the more southern zone the palearctic fauna crossing the whole tableland of Central Asia and Tibet together finds its limit in a more western meridian upon the frontier of the warm subtropical plains of China, falling far short of the Eastern Ocean.

The vertebrate animals of the Ussuri-Littoral country are the same as those in Amouria; only one species of deer (cervus axis), a few small rodents, and fish in the Sea of Japan appearing in its bays like the herrings and pilchards in countless numbers at certain seasons of the year, constitute the difference between the fauna of the Ussuri-Littoral region and that of the Amour.

The population of the Ussuri-Littoral region together with the island of Sakhalin at present already amounts to 90,000 souls. In this number are only 6,500 wandering aborigenes of the country belonging to the Tunguz tribes of Manguns, Golds, Oroks, and also to the Ghiliaks. There are 13,000 Coreans with fixed abodes, and 8,000 Chinese. The Russian immigrants amount to more than 60,000, or 67 per cent, so that contrary of the Yakutsk region, the Ussuri-Littoral, Amour and Transbaikal districts may be considered completely Russian. In the towns of the Ussuri-Littoral country live about 18 per cent of its population, and only one of these towns, Vladivostok, with 13,000 in habitants, has the character of a true town population. It is not then astonishing that in the Ussuri-Littoral country the rural predominate over the town industries, a fact appearing in the number of domestic animals reared by the population, although this figure is lower than in Transbaicalia and Amouria on account of the recent settlement of the country. Thus, there are about 45 horses in the

Ussuri-Littoral country to 100 inhabitants, 55 head of horned cattle, and a little more than 30 sheep and goats. But of course these figures are rapidly growing with the extremely noticeable increase of prosperity of the immigrants in the Ussuri country, who latterly have even begun to pay off all at once the loans of money given them on their immigration.

Completely different is the character of the fourth district of the Amour-Littoral region which may be called the Okhotsk-Kamchatka. This north-eastern part of the region under consideration, embracing, beginning with the basin of the river Uda, the watersheds of all the rivers falling into the Okhotsk and Behring seas, occupies an area of more than 27,000 square geographical miles. The Okhotsk-Kamchatka country is geographically composed of the somewhat narrow north-western littoral of the Sea of Okhotsk, the districts of Udsk, Okhotsk and Ghizhiginsk, the peninsula of Kamchatka or district of Petropavlovsk, Chukot land and the islands of the Okhotsk and Behring seas. In the first part the Stanovoi range, with not more than an average height of 3,000 feet, divides the Littoral Territory from that of Yakutsk, sending forth considerable offshoots, more or less filling up the shore zone, which is on the whole mountainous and in some places descends abruptly to the sea, especially between the basins of the Uda and Okhota. The basin of the Uda and the whole of the extensive bay of that name, penetrating between Cape St. Alexander and the port of Ayansk deep into the mainland by its inlets of Udsk, Tugursk, Ulbansk and St. Nicholas, in front of which lie the uninhabited but elevated and fairly extensive Shantar islands, are nevertheless the best part of the Okhotsk-Kamchatka country, while the wide and roomy northern littoral of the Okhotsk Sea, with its Ghizhiginsk and Penzhinsk inlets entering deeply into the mainland to the north-east, represents the most unsuitable spots in the country for the purposes of settlement on account of its climatic conditions. The geological composition of the north-western coastland of the Okhotsk Sea is very various. Along it crystalline rocks, granite, diorite, porphyry, and even labrador, are met with, as also volcanic rocks, such as trachyte and basalt, as for example in the Marekan mountains at Okhotsk, upon the peninsula of Segneka and on the littoral of the Uyanon inlet in the Udsk district. Among stratified rocks, paleozoic formations were found in Cape Karaul in the same locality.

A great scientific interest, but of very little economical future, is afforded by the peninsula of Kamchatka stretching to the south almost as far as 50° north latitude. The skeleton of Kamchatka is formed by the middle Kamchatka range, the southern half of which consists of crystalline schists, and also of granite, syenite and porphyry, while the northern is composed of tertiary sandstones and volcanic rocks. Upon the boundary between these halves rises the extinct volcano Icha to a height of 16,900. Parallel with the main Middle Kamchatka range, along the eastern shore of the peninsula, stretches a whole row of active and extinct volcanoes, forming as it were the fiery wreaths of Kamchatka. The most southern of the permanently active volcanoes is the small Avacha, whose cone in the year 1848 fell quite in, but in which the extensive crater which was formed after the catastrophe kept constantly smoking from 1852 to 1855. The crown of the system in the neighbourhood of the Avacha bay, upon which is situated the chief town of Kamchatka, is formed by the cones Povorot (7,900 feet), Viliucha (6,750), Strelka or Koriak (a marvellously beautiful cone, scored with longitudinal ribs, 10,630 feet), Avacha (8,700 feet) and Zhupan (8,800 feet); the last two are always active.

Avacha produced frightful eruptions in the years 1825 and 1855. Traces of the first of these eruptions were left in the gullies deeply cut in the sides of the mountain, washed away by the torrents of hot water proceeding from the mass of melted snows. Further to the north, volcanoes are grouped round Lake Kronotskoe. The highest of them, the Kronotsk, is 9,940 feet high. Still further to the north, in view of the Gulf of Kamchatka and the mouths of the river Kamchatka, the principal stream on the peninsula, are collected other volcanoes still active, of which the Kliuchevsk is the highest of all the active volcanoes of Kamchatka, and considerably exceeds in height not only Mont Blanc but even Kazbek, rising from 16,000 and 17,000 feet above sea level. The stream of lava which descended from the Kliuchevsk at the eruption of 1843 almost reached the river Kamchatka. The other active volcanoes of this group also attain colossal altitudes, namely the Krestovsk 11,000 feet, and Siveliuch 10,500 feet. Kamchatka reckons in all 12 active and over 26 extinct volcanoes.

The greater part of the Chukot land is occupied by the basin of the Anadyr, but the Chukot or Behring peninsula proper, forming the extreme north-eastern extremity of Asia, separated from America by Behring Straits, is mountainous and deeply indented with fiords. In the neighbourhood of Kamchatka in the Behring Sea are the somewhat elevated and inhabited Commander Islands partly composed of volcanic rocks, enjoying a world-wide reputation on account of their seal fisheries and other marine industries.

The climatic conditions of the whole Okhotsk-Kamchatka country are extremely unfavourable. The Okhotsk Sea, notwithstanding it does not reach as far north as the Baltic, its most northern entrances being on one line of latitude with the Channel, has the character of a thoroughly polar sea, frequently visited by whales. In the most southern ports of the Okhotsk Sea, Udsk and Ayan, the mean annual temperature is about 4°, the winters, notwithstanding the nearness of the Sea, are severe, the mean winter temperature in Ayan being — 20°, and in Udsk with its more continental climate, — 28°. The summer is cool; in Ayan 11°, in Udsk, 13.5°. If agriculture in Udsk with an average temperature during the five-months vegetative period of about 12° is extremely precarious, in Ayan with 8° it is impossible. In Okhotsk the mean annual temperature is even lower, — 5°; the winters are colder than in Ayan, — 19.5°, the summer the same, 11°. The same also is the mean temperature of the five-months vegetative period, 8°, completely excluding the possibility of the development here of agriculture. Somewhat differently situated is Petropavlovsk, in Kamchatka on Behring Sea, which is subject to a purely marine climate. The average annual temperature, 2°, is here higher than in the Okhotsk Sea, the winter much more moderate, — 8°, the summer almost the same as at the Udsk penal settlement, 13°, but the mean temperature of the five-months vegetative period, 10.6°, is less favourable to agriculture than in Udsk. As to the dampness of the climate and the annual rainfall, the Okhotsk-Kamchatka country presents in this respect two sharp contrasts. The larger southern part of the Sea of Okhotsk and the southern extremity of Kamchatka are constantly wrapped in fogs, drenched with rain or smothered with snow, so that in Ayan the quantity of the annual rainfall amounts to 1,113 millimetres, in Petropavlovsk to 1,240 millimetres, in Ayan summer precipitation 526 millimetres, and autumn 452 predominating, while in Petropavlovsk summer has the smallest precipitation, which is however very great in autumn,

winter and spring. On the contrary, on the whole northern littoral of the Sea of Okhotsk, from Okhotsk to Tigihilsk, in the northern part of Kamchatka and in Chukot land, there is a very small rainfall, reaching in Okthotsk in the course of the year only 190 millimetres, and the winters are almost absolutely snowless, with but 9 millimetres. The climate of the Sea of Okhotsk is further characterized by monsoons, that is, winds blowing in summer from the sea and in winter from the land. In winter the aerial current of the monsoons pours across the crest of the Stanovoi range with such force that men and pack animals cannot go against it. In the late autumn ships avail themselves of these winds on the voyage from Okhotsk to Kamchatka. In summer, on the contrary, strong winds blow from the sea into the Okhotsk shore; they bring with them cold, impenetrable fog and «bus», a fine cold misty rain. These monsoons are explained by the strong heating of the land compared with the sea in summer and its cooling in winter.

The flora of the whole of the Okhotsk-Kamchatka country is poor in the number of species and exhibits but small variety, but the vegetable growth over the whole of its damp part upon the western littoral of the Sea of Okhotsk and in southern Kamchatka is luxuriant. The forests of southern Kamchatka consist only of the two coniferous species, the Siberian fir (abies sibirica Led.) and of the Siberian cedar (pinus cembra L.), and of a few deciduous trees, a birch (betula pubescens Ehr.), an alder (alnus incana W.), a poplar (populus suaveolens Fisch.), a rowan (pyrus sambucifolia Ch.), a willow (salix pentandra L.), to which must be added further a few shrubs belonging to the genera of clematis (atragene ochotensis Pall.), dog-rose (two Siberian species) honeysuckle (lonicera nigra L.), birch (betula Ermanni Ch.) and willow, several species, not counting the smallest bushes of the family of heathers (ericaceæ).

The herbaceous plants, while very poor in the number of species, grow luxuriantly, far exceeding a man's height. Unfortunately among such is a species of nettle with divided leaves (urtica cannabina L.), which has latterly increased here to such an extent that it literally, over large areas, completely crowds out all other vegetation and will be fatal to Kamchatka until its fibre finds some practical application.

The western coast of the Sea of Okhotsk presents a great resemblance in its vegetation with Kamchatka. Some plants however cross over into its southern portion from the Ussuri-Littoral region, as for example is the case with the tree, picea ajanensis. As for the northern coast of the Sea of Okhotsk, and the perfectly treeless tableland, occupying northern Kamchatka, and Chukot land, their flora bears a greater resemblance to that existing under similar climatic conditions in the polar tundra zone of the Yakutsk region.

The land fauna of the Ochotsk-Kamchatka country differs little from the Siberian. Its marine fauna has an incomparably greater importance for the district, for the simple reason that nowhere does the marine fauna of the polar seas come so far south as in Behring Sea and the Sea of Okhotsk whither, together with marine currents and icebergs, the mammals and fish of the Arctic Ocean penetrate in large numbers.

The Sea of Okhotsk, occupying an extensive area between the coast of the Asiatic continent and the peninsula of Kamchatka, and shut in on the south-east by the Kuril ridge, which leaves as many as 20 convenient entrances into it from the Pacific Ocean and the Sea of Japan, is placed in quite exceptional climatic conditions. Notwithstanding its geographical

situation in the temperate zone, between 44° and 62° north latitude, it possesses the type of a polar sea like Hudson's Bay. The greatest depth of the Sea of Okhotsk in its centre is apparently not more than 1,400 to 1,500 feet. While towards the end of the summer in July and August the temperature of the water upon the surface of the sea rises to 7° and even 10°, that at a depth of over 100 feet is below 0° C., and deeper than 700 feet it is —1·5°. Lower than 1,350 feet, the water being salter, the temperature again rises, reaching 2·4° and remains so to the bottom of the sea. But however this may be, the Sea of Okhotsk has all the appearance of what might be called a «tundra» sea, from the valleys of the northern shore of which are carried to the south the so-called «scum» or ice masses floating almost the whole summer on the Sea of Okhotsk. In summer the floating ice collects especially in the southern part of the sea, off the coast to the east of Sakhalin and around the Shantar islands and even in the Amour frith. In Udsk Bay the ice clears out only in July, in Tugursk Bay it holds till August. The marine currents of the Okhotsk sea on its eastern Kamchatka shore flow apparently on the whole in a northerly direction, and from its north-eastern Ghizhiginsk and Penzhinsk extremities swerve to the west, and afterwards following the change of direction of the coast-line turn to the south, passing by the eastern shore of Sakhalin. These currents it is that fill the whole south-western part of the sea in summer with floating ice, in some places forming an obstacle to ships entering it from the Pacific Ocean.

Both the subaqueous flora and the invertebrate fauna of the Okhotsk Sea are extremely rich in comparison with not only those of the Northern Ocean coast, but even with those of Behring Sea. As many as 53 species of seeweeds (algae) have been found in this sea. The algae here, moreover, bear a much greater resemblance to the flora of the Artic Ocean than to that of the Pacific. The majority of the seaweeds of the European Arctic Ocean are also to be found in the Sea of Okhotsk, while the flora of this sea presents very few species common to the Pacific, possessing however not a few peculiar species. The Sea of Okhotsk is extraordinarily rich in mollusks. As many as 70 species of shellfish have been found there, of which 31 species belong to the general polar or circumpolar forms, 15 to the polar forms of Behring Sea, 14 to the Pacific fauna, also met with upon the American coasts, and finally 10, peculiar to the Sea of Okhotsk itself. Twenty-one species of crustaceans have been found, 5 of these circumpolar, 5 Pacific, and 11 peculiar to Okhotsk. There is scant information on the fish of the Sea of Okhotsk, but the pisciae wealth of this sea is very considerable. In particular the «keta» (salmo lagocephalus) and «malma» (salma callaris) are met here in countless shoals. It is a natural consequence of the wealth of the marine flora and fauna of the Sea of Okhotsk and of its polar character, that this sea has ever been the chosen hunting ground of large marine mammals, swimming hither from the Arctic Ocean. Among these must be counted not only several species of seal (phoca barbata, groenlandica, leonina, nautica, numularia and ochotensis), dolphins (phocaena orca, delphinapteros leucas); but three species of whale of which only one has been identified with certainty (balaenoptera longimana). The whaling industry began to be developed here in the forties of the present century, and since 1847 the American whalers have not given these creatures one single year's rest, and have carried away, according to the testimony of the American ship owners, in the 14 years between 1847 and 1861, blubber and whale bone to the amount of 130,000,000 dollars, employing

annually for the purpose 200 vessels. Under somewhat different conditions is Behring Sea, since the surrender to the United States of the Russian possessions in America, enjoyed in common by the States and Russia. It is bounded on the south, that is on the side of the Pacific by the ridge of the Aleutian islands, and on the north communicates with the Frozen Ocean by means of Behring Straits. Situated in more northern latitudes, between 52° and 64° N. lat., and separated from the Pacific Ocean only by a ridge of islands interrupted by sea channels, Behring Sea is a type not of a close mediterranean sea like that of Okhotsk, but of an ocean sea open at both ends, whose climate is still more marine at all seasons of the year than that of the Sea of Okhotsk. It is enough to state that in the southern part of the sea with a mean annual temperature of 3°, the average temperature of the coldest month is a little below zero, and that of the hottest 7°, to understand why all the islands of Behring Sea are devoid of trees. No agriculture is possible upon them, and both these islands and the shores of Behring Sea are incapable of settled colonization, and are for ever doomed to be restricted to the working of their marine resources. The water flora of Behring Sea is poorer than that of Okhotsk, but it cannot be called alsolutely poor, and it is at any rate incomparably richer than the flora of the Siberian coast of the Arctic Ocean.

Thanks to this circumstance and to the abundance of mollusks, crustaceans and fish, this sea like that of Okhotsk has always been a splendid feeding ground for marine animals, which once used to visit these shores in countless numbers, in particular the islands of Behring Sea. The most interesting of these visitors was, till the commencement of this century, the huge animal, 35 feet in length and weighing 50,000 pounds, known by the name of the seacow (rytina Stelleri), first described by the highly talented fellow traveller of Behring, the Russian naturalist Steller; this enormous beast has now entirely vanished from the face of the earth, like the mammoth of the prehistoric age and the great birds dodo and moa in more recent times. The last seacows were killed on Behring island, one of the most remarkable islands in the world, alike from a geographical and from a natural history point of view, in 1780. According however to information gathered by Nordenskjöld the half-castes of Behring island saw seacows last as late as 1855. Another visitor of the islands of Behring Sea, the so-called sea lion or «sivuch» (eumetopias Stelleri Less.) has now become so rare that it is only seen in individual specimens. On the other hand Behring Sea and especially Behring islands are still rich in seals (otaria ursina), of which annually from 10,000 to 50,000 are taken. One other very valuable visitor of the Behring islands is the so-called Kamchatka or sea beaver (enhydris lutris L.), which in zoological respects has nothing in common with the genus beaver (biber) or otter (lutra), but belongs to a genus of animals analogous to the morse (trichecus rosmarus). Of the remaining marine mammals the same occur in Behring Sea as in that of Okhotsk, namely species of seals, dolphins and whales. Behring Sea is also extraordinarily abundant in fish. Some kinds of fish as for example herrings, cod and gwyniad, appear periodically off the islands and shores of Behring Sea from April to July in countless numbers. Finally, upon the shores and islands of this sea breed several kinds of land fur animals, as for example river beavers, otters, arctic foxes, foxes, sables and muskrats.

Possessing such extremely unfavourable conditions, not so much on account of its geographical situation as of its climate, the Okhotsk-Kamchatka region, being included among

the hyperborean countries, has a quite insignificant population. Its 35,000 inhabitants makes a little more than one to the square geographical mile, the number of the Russian contingent not exceeding 7,000, or 20 per cent of the total population. Half of the Russian people are distributed through small towns, containing 11 per cent of the inhabitants of the country. The native tribes consist of wandering Chukches, Koriaks, Kamchadals, Lamuts, and reindeer Tunguz. Evidently, the whole Okhotsk-Kamchatka country, like the neighbouring Yakutsk region of Eastern Siberia, is absolutely unadapted to premanent agricultural colonization and possesses the very smallest capacity for settlement, which can only be enlarged by the development, protection and regulation of the sea industries.

CHAPTER VI.

The Kirghiz Steppe Region.

Its division into the mountain and steppe territories; orography and hydrography of each; climatic conditions; vegetable covering; fauna; composition and distribution of the population in the mountain and steppe zones; importance of cattle breeding to the native population.

THE Kirghiz steppe region in an administrative sense forms the steppe Governor-Generalship and is composed of three territories, Akmolinsk, Semipalatinsk and Semirechensk. In a geographical sense it occupies the southern part of the river region of the Irtysh and the basins of several central Asiatic rivers, not possessing sea communication, but either falling into Lake Balkhash, as the Ili and other rivers of Semirechia, Lake Issyk-Kul and Ala-Kul or losing themselves in the sands or steppe marshes.

The whole Kirghiz region occupies a space of 25,000 square geographical miles and may be divided into two parts, mountain and steppe. The former consists of the whole Semirechensk territory, except the Sergiopol district, and of the Zaissan district of Semipalatinsk, and occupies 7,000 square geographical miles, the latter comprises the whole remaining space of 18,000 square geographical miles.

To the mountain zone belongs the gigantic Russian western Thian-Shan with the exception of its western prolongations, which cross over into the Turkestan Governor-Generalship. Like the Sayan-Altai mountain system, the Thian-Shan at its western extremity branches into separate mountain ridges partly parallel to each other, partly spreading out like the feathers of a slightly opened fan. In the main range of the Thian-Shan on the Chinese frontier a little north of 42° N. lat. is the highest peak, mount Khan-Tengri, lifting itself above a whole group of gigantic snow-clad summits and reaching an altitude of 24,000 feet. The glaciers descending from the Khan-Tengri group feed, on the one hand, the upper waters of the Tekes, that is, the head stream of the chief river of Semirechia, the Ili, falling into Lake Balkhash, on the other hand, tributaries themselves feeding the hollow of lake Issyk-Kul, and yet again, the head waters of the Sary-Dzhaz, which has its source on the northern slope of the Thian-Shan, but breaks through a defile in that range on its southern side and falls into the river Parim, belonging to the system of lake Lob-Nor. At the same time, a little further to the west, the river Naryn, the head waters of the Yaxartes or Syr-Darya springs from the lakes lying on the extensive alpine tablelands or «sazas» of the Thian-

Shan, at a height of 13,000 feet. From Khan-Tengri, the Thian-Shan range already shews a tendency to branch into ridges, lying almost parallel to each other. The southern of these forms the Chinese frontier and is separated from the more northern by longitudinal valleys, in which flow the rivers Sarydzhaz and Naryn. The crests of these separate ridges consist of an uninterrupted series of snow-clad summits, the passes between which attain an absolute height from 10,000 to 13,000 feet, and are very rugged. Finally, the northernmost ridge of the Thian-Shan descends into the long deep valley stretching from west to east of the large and beautiful lake of Issyk-Kul, situated at a height of 5,300 feet. But still further north than lake Issyk-Kul rises also above the limits of eternal snow a double range, that is split into two parallel ridges by a longitudinal valley, the chain of the Zailisk Altai, which is connected with the Thian-Shan by mountain spurs at its northern depressed extremity. At its very centre it reaches a height of 15,000 feet, and over a considerable part of the Zailisk Altai the passes over both its ridges attain an altitude of 9,000 feet and are very difficult to climb. The splendid northern acclivity of the Thian-Shan descends to the broad steppe valley of the Ili, but upon its northern side the Semirechensk range or Dzhungar Altai rises again to the snow line, and at its eastern extremity, within Chinese territory, is in immediate connexion with the Thian-Shan. Finally, still further to the north, in parallel 47° N. lat., stretches the Tarbagatai range also clad in eternal snows, and parallel to the general direction of the Thian-Shan, reaching an extreme limit of 10,000 feet. The deep hollow of Lake Zaissan lying at a height of 1,356 feet, and of the Black Irtysh which falls into it, divides Tarbagatai from the Narym range of the southern ridge of the Altai system. The mountains of the Thian-Shan and of the two Altai consist mainly of the crystalline rocks, granite, syenite, gneiss, diorite, porphyry, and of the metamorphic rocks, crystalline schist; but volcanic rocks have so far not been seen in the Thian-Shan. Upon the mountain slopes are also found rocks in beds lifted up by the crystalline formations. Wherever fossils were met with in the stratified rocks they betray the fact that the latter belong to the paleozoic formations of the devonian and carboniferous systems. Secondary formations, namely jurassic, are found in the continuations and offsets of the Thian-Shan range in the Turkestan territory. At the foot of all the mountains described extend zones excellently watered wherever there are snow peaks, and covered with a fertile soil by the torrents, descending from them and extremely convenient for agriculture and settled colonization, but not otherwise than with the aid of artificial irrigation. Unfortunately, these zones are narrow; they occupy a submountainons tract of an elevation of 1,800 to 5,000 feet above sea level, in the Issÿk-Kul valley even attaining 7,000 feet, above which the cultivation of grain reaches its limit, ceasing also wherever the mountains descend below the snow line and accordingly do not feed any torrents. Moreover these streams lead away into «aryks» or irrigation canals, become quickly exhausted, and passing over into the hot and arid zone lying below 2,000 feet, being absorbed by the sands or rapidly evaporating, fall it might almost be said into the atmospheric ocean. Therefore of the rivers of Semirechia only the full flowing Ili reaches as it should the extensive Lake Balkhash, bounding this region on the north-east, the other quite insignificant streams, Koksu, Karatal, Bien, Aksu, Baskan and Lepsa, either become lost in shallow washes among the sands, or like the last named, in the impene-

trable reeds of the shore of Lake Balkhash. This lake, gradually drying up and retreating from the submountainous region, has left between the latter and its south-eastern shore line a desert and unfruitful space at least 1,000 square geographical miles in extent. Thus, that part of the foothill zone which, from its absolute height, irrigation and soil, may be regarded as an area suitable to colonization, scarcely amounts to more than 1,000 square geographical miles, even reckoning in the valleys adapted to cultivation.

The submountainous zone of the Kirghiz steppe region, extending between the Thian-Shan and Altai, is almost the best part of Siberia, and is remarkable also on account of the fact that it played a great part in the history of the great migration of peoples, beginning with the movement of the Huns to the west already in the second century before Christ and ending with the great Mongolian irruption of the thirteenth century. All the national migrations starting from the interior of Asia were caused by the fact that the nomad population of Central Asia gradually increasing reached the limits of the capacity of the country, and then was compelled to seek an exit either to the far east into the rich and fertile plains of the Chinese Empire, or to the far west, at first into the Aral-Caspian plain, and later, turning the Si-Khai, the «distant west», that is, the Caspian Sea, on the north or south, into Europe. But as the elevated region of Central Asia between the Thian-Shan and the Himalaya range on the side of the Aral-Caspian depression is shut in by such lofty mountains, whose passage is entirely impossible for nomads moving with all their herds, the importance in the history of national migrations of those three wide and convenient intervals, which are situated between the Thian-Shan and the Altai in the region under consideration, is evident. These gaps are, the wide valley of the Ili between the two Altai, the depression surrounding Lake Alacul, between the Semirechian Altai and Tarbagatai, and the Circumzaissan plain between Tarbagatai and the Altai. These three intervals in the mountains served as wide gates for the exodus of the nomads with the low-lying plain, now called the Kirghiz steppe.

The steppe district of the Kirghiz steppe region differs entirely from not only the zone just considered, but also from the neighbouring Western Siberian plain. The Kirghiz steppe is unlike the latter in that it does not present an absolute level. On the contrary it is for a considerable extent intersected by low, but very prominent mountain ridges and masses, consisting for the most part of granite, diorite, diabase, porphyry and other crystalline rocks. Granitic mountains rear themselves above the steppe in the form of crests, while the porphyritic are arranged for the most part in groups of cupola-shaped summits, the resulting effect being a very varied contour. The steppe character of the Kirghiz country appears in the extreme scantiness of its watering and in the almost complete absence of forest vegetation, which only occurs in the north-western corner of the steppe in the Kokchetavsk district of the Akmolinsk Territory. Only the north-eastern portion of the steppe is watered by the Irtysh, while through the north-western flows a large tributary of the same river, the Ishim. All the other rivers of the steppe as for example the Nura, Sary-Su, and Chu bear the character of sluggish prairie streams, disappearing in overflows, which rapidly evaporate in the sandy waste. The low mountain ridges, intersecting the steppe, contain various minerals, such as copper and argentiferous lead ores. In the Kokbekta district of the Semipalatinsk territory occur deposits of gold. But the absence of fuel places mining industry here under unfavourable conditions.

The greater part of the steppe is only suited to the existence of nomads, as it contains very few oases adapted to cultivation and colonization. The climate of the steppe portion of the Kirghiz steppe region is considerably warmer than in the neighbouring cultivated or agricultural zone of Western Siberia, but still more continental. The mean annual temperature in Akmolinsk and Semipalatinsk lying in 51° and 50½° N. lat., is from 2° to 2.5 Celsius, that is, 2° higher than in Siberia. The temperature in winter is — 16°, that of the coldest month — 18.5°, almost identical with the Western Siberia agricultural zone. But the average summer temperature, rising as high as 20° and of the hottest month 22°, is more considerable than in Western Siberia. The difference of temperature in summer and winter, 36°, as also that between the hottest and coldest months, 40°, are greater than in Western Siberia. The mean temperature of the five-months vegetative period (18°) considerably exceeds that of Western Siberia. On the other hand the amount of atmospheric precipitation in the course of the year in Akmolinsk only reaches 229 millimetres, of which 166 fall to the three summer months, and in Semipalatinsk 186 millimetres, of which 80 are in summer. Still less moisture falls in the southern part of the steppe, of which an idea may be formed from the observations taken in the Turgai bordering on this country. There the fall in the course of the year is 122 millimetres, of which only 16 millimetres belong to the summer. In the Hungry-Steppe or Bed-Pak-Dala, lying on the southern frontier of the steppe on the river Chu, there is no rain at all in summer. Evidently there being no possibility of irrigation, as the river Chu is very shallow, this zone is nothing but a dead wilderness.

Incomparably more favourable are the climatic conditions of the submountainous region. According to the averages derived from the observations made in Vierny and Kuldzha, that is, in the foot hills of the Transilian Altai and the Thian-Shan about 44° N. lat., the annual temperature is 9° Celsius, that in winter only — 6°, that of the coldest month — 10°, of summer 22°, and of the hottest month 26°. The difference between summer and winter is 28°, that between the coldest and hottest months 36°. Almost as mild is the climate of Kopal, situated 2° further north in the submountainous region of the Semirechensk Altai. Here the mean annual temperature is 7·5°, of winter — 5°, of the coldest month — 6°, of summer 20°, of the hottest month 21°. The difference between winter and summer is 25°, and between the hottest and coldest months 27°. The average temperature of the five-months vegetative period is 21° in Vierny and Kuldzha, and 18° in Kopal. The mild winters afford a sufficient explanation why in this country not only is gardening possible, which does not exist anywhere in Siberia, but even grape growing. Vierny has a precipitation of more than 560 millimetres a year, of which most falls in spring, namely 226 millimetres, and in summer 115 millimetres. Such a climate may be counted among the best in Russia.

The vegetable covering of the submountainous region is luxuriant and extremely varied, the more so that the climatic zones are there disposed in layers one above another and exhibit perfectly different types of vegetation. The greatest resemblance to the flora of Russia is presented by that of the foothills at an elevation of 2,000 to 7,500 feet, that is, that part which is most capable of development in reference to civilized and settled life, and in which are placed all the Russian colonies of the country. At 7,500 feet the forest vegetation ceases; above spreads the zone of alpine meadows, while below 2,500 feet the

scantily watered country takes the character of the steppe portion of the region under consideration.

The forest growth of the submountainous and mountainous zones, from 2,000 to 7,500 feet in altitude is not very varied. Among the conifers upon the slopes of both the Altai and the Thian-Shan occurs a fine kind of fir, which Russian botanists have named picea Schrenkiana Fisch., but which has proved to be the same as one of the Himalayan species (abies Smithiana Bed.). Further the character of a tree is possessed by the kind of juniper (juniperus pseudosabina Fisch.) more often adhering to the rocks, but at times rising in the form of thick and lofty but very crooked trees, as for example in the Buam defile.

Of the deciduous species here occur the common birch (betula alba L.), the scented poplar (populus suaveolens Fisch.), a low kind of maple (acer Semenovii Reg.) almost identical with that of the Amour (acer ginnala), the common rowan (pyrus aucuparia L.) the wild apple not met with in Siberia (pyrus malus) and the apricot (prunus armeniaca L.) producing even in the wild state very good fruit. The shrubs are somewhat more varied. Among them there are common European species, as for example, sallow-thorn (rhamnus catharticus L.), a bramble (rubus caesius L.), two wild roses (rosa pimpinellifolia D.C. and rosa cinamomea L.), the snow-ball tree (viburnum opulus L.), honeysuckle (lonicera xylosteum and coerulea L.), species of willow (salix nigricans Sm. and salix purpurea L.), and of the conifers, ephedra vulgaris Rich. and juniperus sabina L. There are also Caucasian species, a cherry (prunus prostrata Lab.), gatten tree (cotoneaster numularia Fisch.), currant (ribes petraeum Wulf.), and one species occurring in Finland and the extreme north of Russia and Siberia, hipophoea rhamnoides L. The siberian altaic species include, rosa alpina L., crateaegus sanguinea Pall., lonicera mi-crophylla, W., lonicera hispida L., salix sibirica Pall. But most interesting of all are a few local forms, a traveller's joy (clematis soongorica Bge), berberry (berberis heteropoda Schr.), spindle-tree (evonymus Semenovii Reg.), a rose (rosa platyacantha Schr.). Of the herbaceous plants of the cultivated mountainous zone 70 per cent belong to species also found in European Russia. Of Asiatic species half occur in the Altai-Sayan upland or in the Siberian plain; three species, dracocephalum heterophyllum Benth. and two rhubarbs (rheum Emodi Wall. and rheum spiciforme Royl.) belong to the Himalayan flora and more then 50 species are pecul-iar to the local flora. Especially among these are a few crow's foots (ranunculus soongoricus Schr. and aquilegia lactiflora Kar.), astragals (astragalus leucocladus Bge. and oxytropis mer-kensis Bge.), compositae (cousinia Semenovii Reg. and cousinia uncinuata Reg.), of the calyci-floreae (pedicularis Semenovii Reg., eremonstachys Sewertsovii, Herd.) and finally some beautiful bulbous plants, as heningia robusta Reg. It is remarkable that in this zone a few European cultivated plants are met with growing wild, as for example rye (secale cereale L.) and hemp (cannabis sativa L.).

Quite different is the character of the vegetation on the luxuriant meadows of the Alpine zone. Here there is no forest growth, only a few shrubs forcing their way in, reaching here their highest limit. Among them especially remarkable are two strange forms of acacia (caragana jubata Pall.) and a second species undescribed, which with their thickly clustered foliage and hard woody stalks sticking upright and furnished with long needles, resemble the tails of some large animals, such as the camel. Their dense pale grey leaves beautifully divided as

in all acacias and papilionaceous flowers tender yellow in the case of one species and pale rose in the other are a strange charm to these bushes so characteristic of the Alpine zone of the Thian-Shan. Of the other bushes the following Siberian Altaic species attain the alpine zone: two meadow sweets (spiraea), potentilla fruticosa L., one species of gatten-tree (cotoneaster), and one of tamariks (myricaria Davurica Ehr.), currant (ribes), willow (salix Sibirica Pall.). The local forms are two species of honeysuckle (lonicera humilis Kar. and L. Karelini Bge.) and one currant (ribes heterotrichum Mey.). The Alpine herbaceous flora attains here a peculiar luxuriance and variety, with only 15 per cent of general European and 15 per cent of Caucasian plants. Of the remaining 70 per cent of Asiatic species more than half are met with on the Altai-Sayan «bieloks» and «golets», 7 species on the Himalayan range, while not less than 70 species form a speciality of the local flora and probably will be found again only in the Alps of Central Asia. The 7 species are: anemone Falconeri Th., anemone micrantha Kl., corydalis Gortchakovii Schr., oxytropis Kashemiriana Camb., sedum coccineum Royl., carum indicum Lindl., gentiana Kurroo Royl. Among the 70 species referred to the most remarkable are: one species of aconite (aconitum grandiflorum Kar.), a beautiful species of fumitory, recently adopted for cultivation, (corydalis Semenovi Reg.), 22 new species of astragals, mostly of the genus oxytropis so characteristic of the Asiatic Alps, several thick-leaved plants (umbilicus alpestris Kar., umbilicus Semenovi Reg., sedum gelidum Schr.), umbelliferae (for example, peucedanum transiliense Reg. and Semenovia transiliensis Reg.), ten new species of composite cotton-thistles (as, cirsium nidulans Reg. and cirsium Semenovi Reg., sanssurea glacialis Herd. and sorocephala Schr., alfredia nivea Kar., jurinea suffruticosa Reg.), a beautiful species of primulaceae (cortusa Semenovii Led.), species of gentians (gentiana Olivieri Gris., swertia marginata Schr.) and some beautiful bulbous plants, as crocus alatavicus Sem., orithya heterophylla Reg., fritillaria pallidiflora Schr., fritillaria Severtzovii Reg. and 5 species of onion (allium), of which one (allium Semenovii Reg.) covers the «sazas» or elevated Alpine meadows of the Thian-Shan with its large golden yellow flowers. It is from this characteristic species that the Thian-Shan received its chinese name of Tsun-Lin or Onion Mountains.

The vegetation of the lower steppe zone of the submountainous region, below 2,000 feet, approaches the type of the flora of the whole steppe territory of the Kirghiz region, in other words, to that of the Aralo-Caspian depression. This vegetation in the Kirghiz steppe region is in the highest degree peculiar and distinct, compared not only with that of European Russia and Siberia, but with that of their steppes. In it are clearly reflected the climatic conditions; the intensity of the summer heats, the severity of the winters and the absence of moisture. As already stated there are no forests, particularly no conifers in the Kirghiz steppe, with the exception of the Kokchetav district, but trees grow along the courses of the rivers. Here belong: a particular kind of ash (fraxinus potamophylla Herd.) and four kinds of poplar, populus laurifolia Led., populus nigra L., populus euphratica (Ol. and p. pruinosa Schr.), as also three European sorts of willow (salix fragilis L., s. purpurea L., s. viminalis L.) and a very tall species of barberry with roundish rose-coloured berries (berberis integerrima Bge).

Much more characteristic for the steppe flora are its low growing shrubs, frequently prickly, often covered with a gray or silvery foliage and not seldom characterised by their crookedness. They belong to the families of rues (rutaceæ), haplophyllum Sieversii Fisch. and

latifolium Kar.; leguminosæ, halimodendron argenteum Lam., sphaerophysa salsula Pall., ammodendron Sieversii Fisch.; roses (rosaceæ), Hultheimia berberifolia Pall.; tamariks (tamariscineæ), tamarix hispida W. and myricaria alopecuroides Schr.; currants (ribesiaceæ), ribes discantha Pall.; solanum (solaneæ), lycium turcomanicum Fisch.; buckwheat (polygoneae), three new species, a calligonum and two atraphaxis.

Yet more characteristic are the steppe herbaceous plants. Among them are not more than 40 per cent of European species, and they for the most part belong, like the two species of feather grass (stipa pennata L. and capillata L.), to the steppe forms of European Russia, or like the curious plant of the sandy deserts belonging to the exotic family of balanophoreæ (cynomorium coccineum L.) are met with on the sandy shores of the Mediterranean Sea. Further, besides plants occurring all over the Aralo-Caspian depression, Russian explorers of the steppe flora of the Kirghiz region, such as Karelin, Shrenk, Semionov, Sievertsev, and Baron Osten-Saken, have discovered here as many as 150 new species, characteristic of this flora, among them 30 species of astragals alone, and 10 salicornias (salsolaceæ). The following forms are particularly worthy of mention, leontice vesicaria Bge., megacarpæa laciniata D., physolepidium repens Schr., acanthophyllum spinosum Mey, and paniculatum Reg., orobus Semenovi, Reg.. alhagi camelorum Fisch., eryngium macrocalyx M., dipsacus azureus Schr., karelinia caspica Led., acanthocephalus amplicaulis Kar., saussurea Semenovi Kar., and coronata Schr., echenais sieversi Fisch., streptorhempus hispidulus Reg., non-climbing bind-weeds (convolvulus Semenovi Reg. and subsericeus Schr.), physochlaena Semenovi Reg., eremostachys sanguinea Jaub. and rotata Schr.); 4 species of statice (Semenovi Herd, otolepis Schr. etc.); 5 new species of spurge (euphorbia), irises (iris soongorica Schr.), bulbous plants, rhinopetalum Karelini Fisch. and 4 species of onions; finally some characteristic grasses (gramineæ), as elymus lanuginosus Fr., nephelochloa soongorica Gris., aelorupus intermedius Reg. et cetera.

The fauna of the invertebrates in the Kirghiz steppe region is as peculiar and original as the flora. The difference between it and that of Western Siberia and European Russia is striking. On the other hand it is beyond doubt that this fauna differs very little from that of the deserts and steppes of the Aralo-Caspian depression. The fauna of the submountainous zone presents quite a different character, bearing a close resemblance to that of Turkestan and the Pamir. Among the coleopterous insects not only of the sandy desert of the steppe zone, but throughout the whole of it, the sluggishly moving tenebrionidae, without wings under their hard coherent elytra, predominate. On the contrary, in the mountainous zone of the Thian-Shan and Alatau the tenebrionidae, who like the dry steppe, are met with in smaller numbers, while here occur numerous kinds of carabidae, among which are very rare mountain forms characteristic of the Central Asiatic mountainous zones.

Of the vertebrates a great number of birds come during winter from the far north and nestle in the steppe and submountainous regions. The ornithological fauna of this region is especially rich. In the warm valleys exist different species of fowls, as also the most beautiful sorts of Asiatic pheasants; on the rivers and lakes is found a great variety of birds, native of the Mediterranean basin, among which are covies of pelicans; and on the

Alpian zone, numbers of mountainous birds, the greater part of which are natives of the Asiatic mountains.

Even the fauna of the mammals is much richer and more varied than in Siberia. The tiger and the irbis (felis irbis) reach the northern limit of their distribution in the reeds of Balkhash, but occasionally stray northward into the neighbourhood of the Alatau. Wild boars occur in all the submountainous zone, in the Thian-Shan and Transilian Alatau. There are two species of bear belonging to the Pamir and the range of the Himalai (ursus thibetanus and isabellinus). Besides the «arkhar» (ovis argali), extremely common in the alpine and subalpine zones of the Thian-Shan and both Alatau, the kochgar, a mountain sheep first described by the celebrated traveller, Marco Polo, and subsequently called in his honour, ovis Polii, from the horns and skeletons found in abundance on the Pamir, breeds in the wildest parts of the Thian-Shan. This species was long considered extinct, until discovered by the most recent Russian travellers, Semionov, Sievertsov and Przhevalsky. In the mountainous zone of the submountainous region also breed the cervus pygargus, capra sibirica, several species of «saiga» (for example antilope subgutturosa) and the porcupine (hystrix), while the steppe zone contains «kulans» (egnus hemionus).

Passing next to man, it must be observed that the whole population of the Kirghiz steppe region amounts to 1,860,000 souls, of whom the immigrant Russians form only 14 per cent (260,0C0), and the remainder, 86 per cent, belong to the native tribes of Central Asia. Of the latter, the Tartars and Sarts (35,000) live principally in towns and permanent settlements, the Dungans and Taranch (86,000) employed in agriculture, may also be reckoned to the settled population of the country, while the Kirghiz (146,000) and Kalmyks (25,000) are nomads, living almost exclusively by cattle breeding. The Kirghiz, in number the predominating tribe of the region, speak a Tiurk idiom, but in effect in their origin form a motley amalgamation of various tribes, who were attracted hither in the XIIIth century by the last mass migration of Mongols and who squatted here, on the road taken by the great migration, on the first spots suitable for a nomad life met with by the wanderers from the mountainous region of Asia. As among the people who entered into the composition of the Kirghiz alliance, the Tiurk tribes had a numerical preponderance, all the Kirghiz adopted their language, but the various clans and tribes have preserved to this day their clannish and tribal names, thus betraying their true nationality. The total number of the Kirghiz exceeds 3,000,000 souls, of whom 1,470,000 dwell in the steppe Governor-Generalship, 760,000 in the Turgai and Ural territories, 740,000 in Turkestan, and over 140,000 in the home Kirghiz Bukeev horde in European Russia.

In the two component parts of the Kirghiz steppe region the population is unequally divided. In the steppe part of the region live 1,000,000 inhabitants, making 55 to the square geographical mile. Russians form here 20 per cent, or 210,000, of the population, merely because the former Siberian Irtysh colony, except three large towns, Semipalatinsk, Omsk and Petropavlovsk, is wholly settled by them, as well as a whole string of Kossack camps or «stanitsas» and hamlets which served formerly as the fortifications of the frontier line. Within the steppe zone there are very few permanent Russian settlements, as suitable spots for agricultural colonies occur here only as rare and limited oases, and if the Siberian Irtysh

ine be left out of the account, the proportion of the permanent Russian population in the Kirghiz steppe will not exceed 2 or 3 per cent. On the whole the towns of the steppe zone contain 100,000 souls or 10 per cent of the total population. Of the towns, actual importance as centres of trade and industry, possess only Omsk (34,000 inhabitants), Semipalatinsk (18,000 inhabitants) and Petropavlovsk (16,000 inhabitants).

The submountainous zone of the Kirghiz region is situated under different circumstances. Here 860,000 inhabitants find a place, there being over 120 to the square geographical mile. Russians form 7 per cent of the total population or 60,000. Adding to them the Tartars and Sarts which have their permanent abodes in the Russian settlements, as well as the agricultural Dungans and Taranch, the number of the fixed population forms 18 per cent, while in the towns alone dwell less than 6 per cent of the total population (50,000). Among all of them Vierny, with its 25,000 inhabitants, alone possesses the importance of a true town, and which enjoyed a flourishing existence until its destruction by an earthquake.

The distribution of the population in the submountainous zone and in particular the relation of the fixed population to the nomad, can be made quite clear by dividing the whole submountainous zone according to absolute altitude into vertical zones or levels. The lowest or steppe zone, the hottest and driest, and in winter the freest from snow, occupies the portions of the foothills lying below 2,500 feet, and is taken up with the winter quarters of the nomads, who here find abundant fodder for their herds under the snow. This fodder is formed of grasses, such as schismus minutus, crypsis schoenoides, small species of triticum and the like which rapidly dry up on the approach of the summer heats. The true submountainous zone, following with an elevation of 2,500 to something over 5,000 feet, includes all the fixed settlements and arable land of the country and represents a level occupied almost exclusively by a permanent population, through which the nomads pass without stopping by definite roads or tracts, proceeding in summer from the winter quarters to their beautiful cool mountain pastures. Before the arrival of the Russians, the Kirghiz were employed, although to a limited extent, with agriculture in this cultivated level, and had here their fields which they sowed with the aid of irrigation on their way to their summer grounds. With the coming of the Russian settlers, the Kirghiz surrended to them the whole of the second level of the country, but lost nothing by this, as the abandonment by them of inconsiderable tracts of arable land was fully compensated by the sale to Russian agriculturalists of the produce of Kirghiz cattle breeding; the former supplying them in turn with grain. The third level, from 5,000 to 8,000 feet in altitude, is the forest zone, providing a subsidiary industry to the Russian permanent settlements of the submountainous zone. Finally, the fourth level, upon which the Kirghiz have their excellent summer pastures, extends from 8,000 to 11,000 feet, that is to the limits of eternal snow. This is a zone of alpine meadows, occupied only in summer almost exclusively by Kirghiz nomad camps.

The pastoral life of 80 per cent of the population of the country is reflected in the number of domestic animals bred in the Kirghiz steppe zone, the proportion of which to every 100 inhabitants here attains the maximum dimensions for the whole of Siberia. To each 100 inhabitants fall 100 horses, the absolute number being 1,800,000, 60 large horned cattle of a total 1,050,000, and 580 goats, the absolute number being 10,400,000. Finally,

even the quota of camels is 15 head to each 100 inhabitants. This is a direct proof of the fact that the Kirghiz steppe region is preeminently a cattle-rearing country and that only its foothills are capable of affording all the conveniences albeit of, a narrow, yet almost the best area for colonization in all Siberia. And this same area of colonization having already done its service to Russia, as only thanks to its development did the Russians become masters of Turkestan, has even to-day an immense importance for Russia, as the most solid and indestructible connecting link between the genuine Russian possessions in Siberia and Russia's Turkestan region.

CHAPTER VII.

Tenure and use of land.

The foundations of land tenure and the forms of land usufruct; the dividing of Siberia into districts and their general character: the northern borderland, the transition zone, the agricultural region, the steppe districts, the Amour tract; agriculture; sketch of the conditions of the soil, systems of field culture and rotation of crops; tillage and cost of production of breadstuffs; proportion of seed for different crops; sale of grain and grain prices; agriculture in the steppes and the Amour tract; raising of cattle among the peasants, its extent and importance; kinds of animals, diseases; live stock industry among the Kirghiz.

THE whole of Siberia, alike that which is completely uninhabited and that which is settled by peasants of Russian origin or by the aborigines of the country, natives belonging to various tribes and classes, is reckoned as crown land. Exceptions to the general rule are, first of all, the southern part of the Tomsk government which forms under the name of the Altai mining district the property of His Majesty's Cabinet, and next a series of small parcels granted and sold in the fifties to various private persons, the lands of the monasteries, of the town communes, et cetera. But all forms of private land holdings are completely lost in the vast mass of Crown lands, both on account of their insignificant extent, and as regards their economical importance. Private owners have nowhere started regular management of their property; some exploit their estates by means of leasing their land to the peasants, and others have utterly neglected them, drawing from them no revenue whatever.

In Western Siberia the sale of lands to private persons continued until recent years when, with the abolition of the west Siberian Governor-Generalship, an Imperial order was given to discontinue the sale of Crown lands. Private owners in Western Siberia do not possess more than 300,000 dessiatines, exlusive of course of the Cabinet lands.

A very considerable portion of the lands belonging to the Crown and to the Cabinet, almost exclusively forests or regions not adapted to cultivation, is under the immediate control and disposition of the Government and the Cabinet which, where there is a possibility of so doing, draw an income from them by felling the timber and leasing the meadows and pastures, fishing rights et cetera. Another part, enormous in extent but insignificant in respect to the number of inhabitants living thereon, and its capacity for cultivation, namely,

the whole of the far north, consists entirely of urmans, taigas (uninhabited expanses of forest), tundras and wildernesses, a part being absolute desert, and a part being at the disorderly disposition of tribes of wandering natives. Finally, all the lands best fitted for agriculture and cattle raising, are in the usufruct of the peasants and of the more civilized natives. The latter use the land either on the basis of mere actual prescription, or on that of ancient documents existing in a great many native communities. The foundation of the peasants usufruct is extremely varied in its nature. The activity of the Government in introducing order into the use of the land by the peasants, which has already continued during several decades, is even now far from showing complete results. There still remain not a few peasant communities, and even whole volosts, in which the existing enjoyment of the land is restricted within no definite limits. The peasants dwell upon the Crown lands and use them to the extent permitted by their working powers and the amount of their capital. They plough, mow and harvest, cut timber, catch fish, as the expression is, wherever only «hatchet, scythe and plough may go». But the greater part of the peasant population use the land within definite limits, although these limits are without complete legal force.

Siberia has not yet seen a final land survey, like that which has established the surface relations of European Russia. Land has been allotted to the greater part of the peasants in the proportion of eighteen dessiatines per caput of the male population, according to the returns of the tenth census of 1859, with the addition, whenever possible, of three dessiatines for convict settlers. In some cases the provisions of land were made for a whole volost with a population ranging from 4 to 15 thousand souls, in others separately for each settlement; in yet other cases, for small groups containing each a few villages. In the first case, the territory of the whole volost was surrounded with one common boundary line, within which the peasants of all the settlements were given the right at their discretion either to use the land in common or to confine themselves by mutual agreement to separate subdivisions thereof. In the second case, such estates were laid out for the settlements by Government surveyors, and the volost consequently lost completely its territorial unity and preserved only an administrative importance. Finally, in the third case, both the volost and the settlement, remained only administrative units, while the group of settlements became the territorial unit.

The use of the land within each separate territorial unit, more or less extensive, was also organized in extremely various ways. It is true, the Russian peasant, at all times and in all places, at any rate in the explored parts of Siberia, brought with him the communal principle and even ingrafted it upon the natives. But this single principle was clothed in the most various forms. This is indeed comprehensible, for the forms of land tenure, if not entirely, yet to a considerable degree, are conditioned by the density of the population and the relative supply of land; and in this respect Siberia presents an extraordinary variety. Side by side with localities where there is, even till now, much more land than the population can till, there are, especially in Western Siberia and in particular in the Tobolsk government, not a few places where there are not more than six to eight dessiatines of land really fit for agriculture, per male inhabitant. There are, finally, even localities where the tillable land has to be created by means of artificial irrigation, or on the contrary, by the removal of the superabundance of water. While furthermore, some places rich in arable

land suffer from a lack of meadows or from an absence of trees; others, on the contrary, present an unbroken dense forest or are exceedingly rich in meadows and pastures, but little suited to agricultural industry. It is evident then that all these and similar distinctions could not fail to be reflected in the forms of land tenure. These forms in Siberia exhibit an uninterrupted series, allowing the observation of the development of land usufruct under the influence of the increasing density of the population. Under such circumstances the high interest afforded by the investigation of Siberian institutions, that living spray from the history of the primitive forms of land enjoyment, is perfectly intelligible. Here of course it is impossible to refer to these institutions otherwise than in the most general terms, to characterize the most important types of the use of land, corresponding to the principal stages through which the people of the country are gradually passing.

In localities comparatively recently and very sparsely settled, mainly in Eastern Siberia and on the Amour, there predominates a form of land use which externally presents much resemblance to homestead, personal land tenure. The commune here has not yet had time to form, or if it exists, has no need to show its power. There is so much land that each may plough, mow, put under garden or hedge in as pasture lands, any space he likes, without incommoding any one else thereby. As a result of such enclosures, z a i m k a, or farmsteads are formed. Each peasant, even if he have a home in the village, builds himself structures in the field or forest wherein he lives in the summer and sometimes all the year round, all the land surrounding such a building becoming his z a i m k a, his sole property, where he alone ploughs, mows and pastures his cattle. Z a i m k a, in the sense of actual land enjoyment, is moreover perfectly possible without any buildings. The rights of the owner to the z a i m k a are almost unlimited. He owns within its bounds not only the land, which he is actually tilling at a given time, but that which lies waste and no one has the right to molest him thereon. Such land passes by inheritance, may be sold and leased, although the right in consequence of the abundance of free lands has rarely an opportunity of being realized. No one interferes with the occupant in his acts or dispositions referring to his land. The extent of the z a i m k a depends exclusively upon the degree of prosperity of each given owner. The z a i m k a of a rich man embraces 500 to 1,000 or more dessiatines, the average owner occupies 50 to 60 dessiatines, and a poor peasant, 5 to 10 dessiatines; the poor man cannot have any grudge against the rich man, as no one prevents him from seizing 1,000 dessiatines or more of the free land, if he wishes.

However there comes a time when there are no more free lands left, at any rate of good quality. Every convenient plat of ground has entered into the general total of the z a i m k a s, but nevertheless the growing population and immigrants require land for their use as well. Then the occupation form loses its r a i s o n d'ê t r e, and gradually a new form, the v o l n a i a or free form of land usufruct is introduced. The essence of this form, observed principally in the governments of Tomsk and Tobolsk, consists in this, that everyone has the right only to that land into which he puts his labour, and only so long as he continues to till it. The peasant owns arable land so long as he ploughs it and sows it, but the moment he leaves it to rest, the land becomes free and the first comer may occupy and plough it afresh. Upon meadow lands the grass which has grown without individual labour

is free. Everyone mows where he will, and the hay becomes the property only of him, who cuts and preserves it. Free and accessible to all is the forest also, and only he may seize for his own exclusive use a given portion of wood, who has enclosed it with a ditch, cleared it of dead wood, and in general expended his labour upon it to protect it from fire. Finally, the pastures are also free; every member of the community may feed his cattle over the whole area appointed by the community for this purpose, but no one may enclose a single plat of pasture for his own exclusive use.

The occupation and free forms of enjoyment of land till to-day prevail in the greater part of Siberia; but with the increasing density of the excess of land, compared with the standard of labour, the free form begins to become as oppressive for the immigrant population as the occupation form had once appeared to be. Then gradually, at the cost of a severe struggle between the different groups of peasantry, entering into the composition of the community, a passage is accomplished to a communal form of enjoyment of the land in the narrow sense of the term, accompanied with a redivision. This passage begins ordinarily with that group of lands of which in each given place there is felt comparatively the greatest lack. The free and occupation forms, on the contrary, are preserved longest of all in regard to those lands, of which there is an abundance in the given commune and to those whose bringing under cultivation demands particularly a great expenditure of labour. The passage to a re-deal begins sometimes with the ploughed land, sometimes with the meadows, and sometimes with the forests or cedar groves.

The very forms of repartition met with in Siberia are exceedingly various. In regard to meadows everywhere, and when there is comparatively much arable land, forms of redistribution prevail which are completely distinct from those elaborated by the commune of European Russia. The principal distinctive peculiarity of Siberian repartitions is the striving to avoid the breaking up of the land into small lots; the latter are seldom less than a dessiatine. Another not less characteristic feature is, that it is not so much the area which is taken as the basis for the distribution of the land among the commoners, as the productiveness and other qualities of the soil, which determine its value for each given owner. Each commoner is allowed to take at his discretion a greater quantity of poor land remote from the homesteads or inconveniently situated, or on the contrary, a smaller quantity of good land or that which is situated near the house. In the localities where there is little arable land, principally the northern region of the agricultural part of the government of Tobolsk, on the contrary, methods of repartition have been established, on the whole agreeing with the Great Russia methods and characterized by a strict quantitative and qualitative equalization which is attained by breaking up the allotment per head into a large number of small lots.

The lands belonging to the Crown, peasant or native, occupied or waste, cover in Siberia vast areas measured by millions of square versts and hundreds of millions of dessiatines. Compared with the few millions, now forming the population of Siberia, these expanses seem infinite and the thought involuntarily arises that Siberia can make room for many tens of millions more of inhabitants, and for many tens, if not hundreds, of years guarantee European Russia from over population and serve, as it were, as a reserve, capable of taking

from the governments, suffering from a lack of land, all their surplus population. But if it be remembered that almost all Siberia lies in the same latitude with the expanse of British North America unsuited to agriculture, and only its southern borderlands are in the same latitude with the northern borders of the United states; if it be further remembered what are the climatic and, in general, the natural conditions of the greater part of Siberia, it will be clear that only a part of Siberia is destined by nature for civilized life. The vast regions of the north of Siberia are doomed for all time to remain entirely, or almost entirely, uninhabited and inaccessible to cultivation. Nor is this all; even where this cultivation already exists along the rivers at the present time or may develop in the more or less near future, the interriverine spaces present vast swamps, tundras or mountainous regions, absolutely unadapted to cultivation. Such a character is possessed by the central part of the Tobolsk and the northern part of the Tomsk governments, almost the whole of the Amour country, and the same may be said of the three steppe territories where but insignificant patches are suitable for agriculture, and all the remainder presents an expanse of salt marsh, probably doomed forever to remain the scene of Kirghiz nomad life.

The proper arable part of Siberia embraces at the present time four governments of the original Siberia, western and eastern, with the exception, however, of their northern regions, namely, in the government of Tobolsk, the Berezov and Surgut districts, and the northern halves of those of Tobolsk, Tourinsk and Tarsk; from Tomsk must be excluded the Narymsk country; from the government of the Yenisei, the Yeniseisk district; in Irkutsk the districts of Kirensk and Verkholensk. Besides this, almost the whole of Transbaikalia has a cultivable character, and the banks of the Amour and the Ussuri in the far east, although here as will be seen, cultivation exists rather in the future than in the present. Finally, in the steppe territories agriculture exists and is capable of development only in a few parts of the following districts: Kokchetavsk, Atbasarsk and Petropavlovsk in the Akmolinsk territory and in Semipalatinsk and Pavlodar in that of Semipalatinsk. Furthermore, are to be named the regions of artificial irrigation in the Zaisan district of the latter territory and in the foothill tracts of the territory of Semiretchensk.

Next, the whole north, namely, the above enumerated districts of the four governments of original Siberia, the whole Yakutsk territory, with the exception of the insignificant riverine zones, Kamchatka and the littoral of the Okhotsk Sea; all this consists of millions of square versts of tundras and wildwoods growing on a swampy soil. The Russian population is here confined to the officials of the local government, and to merchants and their agents, engaged in barter with the native nomads. The remaining population, the density of which moreover does not exceed three, and in the territory of Yakutsk even less than one inhabitant per square mile, consists of native Samoyeds, Ostiaks, Tunguz, Yakutsk, Kamchadals and others, who live exclusively by hunting and fishing. The produce of these industries partly serves for their own consumption, but mainly goes in barter for bread and other provisions furnished by the Russian traders. Between this northern, absolutely uncivilized portion of Siberia and its purely agricultural regions stretches as it were a zone of a transitional character. To it belong, in the government of Tobolsk, the southern half of the Turinsk and the central part of the Tobolsk district, as also

the northern volosts of the Tarsk district; in the government of Tomsk, the northern borderlands of the Tomsk and Marinsk districts; in Yeniseisk, part of the district of the same name; in Irkutsk, the Tunkinsk country and some other places. This transitional zone is characterized by the circumstance that agriculture there attains at last a more or less considerable development, while dividing its part as the main source of prosperity with several other industries. Along the rivers everywhere extend great reaches of lands suitable to cereals but their extent is insufficient to occupy the whole labour of the population and completely secure its well-being. At the same time the forests and waters open a wide field to the development of trapping and fishing, the cedar nut industry, the cutting of fuel and the felling of timber and a few household trades. In the population of this transitional zone the Russian peasants are mingled with more or less russified natives, and in the mode of life of both races no substantial difference can be observed. .

Natives, in the main Buriats, still compose a considerable part of the population in those portions of the cultivated zone proper of Siberia lying further to the east, and whose settlement by Russians was accomplished comparatively recently. In the agricultural districts of the Irkutsk government the natives still form about 17 per cent, in the Thansbaikal territory, 30 per cent of the population; in the cultivated region of the governments of Yenisseisk and Tomsk the number of natives is already quite insignificant, while in the purely agricultural districts of the government of Tobolsk they are almost non-existent.

The chief characteristic feature of the cultivated tract of Siberia consists in the considerable dimensions attained by agriculture and in its predominating importance, as the fundamental source of the prosperity of the population. The average extent of the sown area per household of the rural population, including under this term peasants, natives aud convicts, according to the latest statistical data, is as follows:

In the	southern districts	of the	Tobolsk	government	. .	5.4 des.
» »	central part	» »	Tomsk	»	. .	5.8 »
» »	agricultural region	» »	Irkutsk	»	. .	5.4 »

and to every 100 souls of the actual population there is an area sown with grain, as below:

In the	southern districts	of the	Tobolsk	government	. . .	104 des.
» »	central part	» »	Tomsk	»	. . .	87 »
» »	agricultural region	» »	Irkutsk	»	. . .	97 »

The relation between the production and consumption of grain varies of course for every volost, and not unfrequently for an individual settlement, in dependence upon the quantity of lands suitable for grain growing and their conditions of soil. Taken as a whole, the agricultural region not only supports its population, but yields very considerable surpluses of grain. The sale of these surpluses is the chief source whence the population pays its taxes and satisfies its principal wants. According to the latest data the people of the agricultural districts of the Irkutsk government consume on an average crop not more than about 59 per cent of the grain raised; that of the north-eastern corner of the agricultural region of

the Tomsk government, about 66 per cent; 41 per cent in the first of the said localities, and 34 per cent in the second, form saleable surplus. And yet the regions in question are far from belonging to the number of the most fertile areas of agricultural Siberia. In such localities as the Altai mining district, the Minusinsk district of the Yeniseisk government, the best volosts of the south-western districts of the Tobolsk government, the proportion borne by the produce of grain to its consumption is yet considerably more favourable and the saleable surplus, on average harvests, forms not less than half of the whole yield. The export of grain, principally spring wheat from Western Siberia, reached in recent years 10,000,000 to 12,000,000 pouds annually. The total quantity therefore of grain raised in this part of Siberia forms not less than 85,000,000 pouds a year. It must not be forgotten, however, that in the pale of the agricultural tract of Siberia occur such patches where the land, on account of the bad conditions of soil and climate, cannot feed the population. But such spots are very small and their population exists upon the surplus grain of the nearest more fertile localities.

However this may be, the whole economical fate of the population of the cultivated zone of Siberia is entirely determined as a general rule by the condition of agriculture and of cattle-breeding so closely connected therewith. Where the land is good the population attains a high degree of wealth and grows alike by natural increase and by the tide of immigrant elements; when the land is poor, the population ordinarily lives in poverty and not unfrequently dwindles away in search of better places of settlement.

Trades and industries speaking in general terms, play the least considerable part in the economical life of the population of the agricultural tract of Siberia. But there are within the agricultural zone such regions also where agriculture loses its position as the sole source of prosperity and either shares it with other earnings or even altogether yields it to the latter. Thus, first of all may be pointed out many localities lying along the banks of great rivers where a very essential part in the economic life of the population is played by fishing, service on vessels and in the neighbourhood of fine forests, the raftage of timber. In localities nearly approaching uninhabited taigas and urmans great importance is possessed by hunting, the gathering of cedar nuts, and in the presence of a good market, the felling of timber. The volosts bordering on such great town centres as Tomsk, Tiumen, Krasnoyarsk, Irkutsk have the character usual for suburban regions. Agriculture is little developed in them or non-existent, and the population lives by market-gardening, dairy farming, the furnishing of hay and wood fuel, the letting in summer of villa residence, works in connexion with the cleansing of the streets and other similar occupations, directly serving to satisfy the wants of the town population. There are furthermore a few regions engaged in household industries. The largest of these surrounds the town Tiumen stretching therefrom to the north-west; the second is situated around the town of Tomsk; other such small industries occur in all the governments of the agricultural tract of Siberia. In all these regions articles of wood are principally manufactured, as also the results of wood distillation. These products are destined partly for the needs of the local true peasant population, partly to furnish the caravans moving over the great Siberian and other tracts. But the importance of all the enumerated non-agricultural earnings in the general economy of Siberia and in

particular in its agricultural zone is absolutely insignificant compared with the part which the great Siberian tract plays, and still more in former years. Formerly when yet there was no communication by steamer, this tract was the sole artery uniting European Russia with Siberia, and through it, with China. The traffic over the tract both summer and winter was enormous. The conveyance of travellers and goods, posts and prisoners, local officials and bodies of troops, absorbed almost the whole working power of the population along the tract. Comparatively few were engaged in agriculture along the tract and even they did not see in it their principal occupation. The mass of the population lived exclusively or almost exclusively by the trade of carriers or innkeepers. At the present time the importance of the tract is far from being what it was. The steamer communication on the Irtysh and Obi has almost completely killed the summer traffic upon the section of the tract between Tiumen and Tomsk, the steamer communication on the Chulym has absorbed a considerable part of the traffic between Tomsk and Achinsk. The tract here only wakes up in the winter, and even then the traffic now is much less than formerly, and is far from yielding the former profits to the tract population. The latter has therefore thrown itself into agriculture, the cultivated patches have everywhere been increased, and will be still further enlarged in future, and the population of the tract have already lost a considerable part of their former peculiar character.

Here the general description of the agricultural zone of Siberia may be closed. As far as concerns the outlying regions, mention has already been made of the territory of Yakutsk as a district absolutely uncultivable and inhabited by native trappers and fishermen. Here it may be permitted to indicate only the importance of the Lena tract, along which almost all the Russian population of the territory is gathered and which furnishes thereto its chief source of existence. The three steppe territories as already intimated contain cultivable oases where agriculture both exists and is capable of further development. Beyond these the whole expanse of these territories serves but as the wandering grounds of the Kirghiz, who live exclusively by the products of their cattle raising and do not promise at any near future date to pass over into the agricultural or industrial state. The attempts at such a passage to agriculture met with among the Kirghiz are as a rule quite isolated and devoid of any serious importance. Even the Kirghiz settled in separate households in the peasant colonies of the southern part of the Tobolsk government and who have not unfrequently accepted orthodoxy are also employed exclusively in cattle raising, the pasturing of cattle on land hired from the peasants, not seldom in horse-stealing; only the more wealthy among them sow oats, in order to feed their numerous horses. The only exception to this general characterization are the Kirhgiz living in a part of the Zaisan district and upon the foothills of the Semirechensk territory, the so-called Kirghiz of the Great Horde and the Dikokamenny, whose life is woven of a very curious combination of nomad existence with very intensive irrigational agriculture. These Kirghiz too, like the others, have their places for winter and summer roaming, but from the latter they wander off several times in the course of the summer to their lands under tillage in order to water, plough and sow them, and to harvest the grain. On the arrival of the Russian population the Kirghiz not only taught them their own agricultural methods, but surrendered to them a considerable part of their irrigated lands, while

themselves transferring the centre of gravity of their economy to cattle raising. By doing so they lost nothing as the profitable sale opened to the produce of their cattle breeding, which appeared with the arrival of the Russians, fully compensated them for the contraction in the extent of their agriculture.

Passing at last the Amour border land, it appears that Amouria may be split up into three parts, the first of which is situated above the confluence of the Zeya with the Amour, the second below the confluence of the Bureya, the third between the lower reaches of these two streams. In the first tracts the only lands at present suitable for cultivation are those situated on the second terrace of the Amour valley, the first terrace is inundated several times every summer and therefore is unsuited to either settlement or agriculture. Outside this valley the region presents partly mountain ranges, partly tablelands scored with gullies and valleys, whose summits, thanks to the dense forest covering them, never dry up properly and therefore have to a considerable degree a swampy character. With the gradual felling and burning of the forest, the soil of the tablelands is slowly drying and becoming suitable for cultivation, so that in time the latter will undoubtedly take in a wider and yet wider tract. But this question is incapable of rapid settlement, and at any rate at the present time the whole mountainous part of the locality under consideration is absolutely desert and affords only an arena for the industry of the trappers of the Amour population. The main occupation of the latter is agriculture. Sowing on an average four to five dessiatines per household the local population on the whole secures its own provision but has no surplus grain for sale. The chief supplementary earnings are the carriage of goods and the furnishing of hay to the gold mines, fishing, trapping and the supply of wood fuel to the steamers. Upon section between the lower reaches of the Zeya and Bureya the zone adapted to cultivation is much wider, here not only is the second terrace of the Amour valley suited to agriculture, but also the watershed of the Zeya and Bureya, which has earned the name of the «prairie of the Amour». The population, partly Russian, partly Manchurian, is here much denser than in the rest of Amouria, the extent of the arable land much greater, and grain is produced not only for home consumption, but for sale. But in this district, as in the whole of Amouria, climatic conditions stand in the way of the development of cultivation; there is in effect an excess of moisture. The beyond measure damp and rainy climate has a sinister effect upon both the quality of the grain and upon the raising of live stock. The latter industry so far brings hardly any profit to the local population. For the development here of cultivation, there is wanted either a change in the climatic conditions, of which there is a hope in the future, or the elaboration of methods of agriculture and cattle raising more suitable to these conditions. Such a change in the climate was observed by the latest explorer of the country, the Academician Korzhinsky, as a result of the comparison of his own observations with the statements made by the academician Maximovich, who travelled in the Amour region thirty years earlier.

A still greater excess of moisture is met with in the most eastern borderland of Amouria and indeed of the whole of Siberia, namely in the Ussuri country. Here it is impossible to sow grain otherwise than in ridges leaving between them trenches for the drainage of the water and the free movement of the air. The development of cultivation is

here still less possible than in the rest of Amouria otherwise than after a preliminary drainage of the country, or by the adoption of some other measures for combatting the excess of moisture.

With this may be closed the general economical appreciation of those regions into which Siberia falls according to the degree of development of the practice of agriculture, and the transition may now be made to the survey of the separate sources of prosperity of the population of Siberia. In consequence of the predominating importance of agriculture for the main mass of this population the largest share of attention must be devoted to its description.

The fashion and character of agricultural production are determined, on the one hand, by the denseness of the population, the conditions of sale and other similar economical questions, and on the other, by the natural and physical conditions, mainly those dependent on soil and climate. The density of the population and the climate have been discussed in the preceding descriptions. The discussion of the conditions of sale and of the general economical situation will appear below. Here then it is necessary to give a general characterization of the Siberian soils. Unfortunately, the data existing upon this subject are far from complete. An exact scientific exploration of the soils, accompanied by chemical analyses, has hitherto been carried on only in two limited regions, in one district of the government of Irkutsk and in the Barabinsk steppe in the Tomsk government. Further descriptions of the soil exist in reference to a few districts of the Tobolsk and Tomsk governments and to the Amour country. These are founded upon mere surveys, connected with measurements of the depth of the soil and in a few cases only with the determination of samples of it, based upon a superficial inspection, more rarely by means of the method of subsidence, the determination of the humus contained, and other more exact methods. In reference to many localities there exist no published indications whatever upon the conditions of the soil. It may thus be said that the soil of Siberia still awaits a serious investigation. A great step will be made in this direction in the near future when fruit shall be borne by the expedition now projected by the Ministry of State Domains, having for its object the exploration of the conditions of the soil of the whole expanse of Siberia, traversed by the line of the Great Siberian Railway. Till then it is only possible to present the most general sketch of these conditions, only a superficial characterization is possible, far from satisfying the demands of a strict scientific description.

The greatest variety and at the same time the fullest account are met with in the case of the soil conditions of the government of Tobolsk. That portion of the latter possessing agriculture may, in respect to the situation of its arable lands and of the conditions of the soil, be divided into three zones, the northern, lying approximately between the parallels 58° and 59° and embracing the northern parts of the districts of the Turinsk and Tobolsk; the middle zone, lying between 56° and $58^1/_2$°, and including the southern halves of the above named districts, the whole Tiumen district and the northern parts of those of Tarsk, Ishimsk and Yalutorovsk; and the southern, taking in the southern portions of the last named three districts, the whole of Kurgansk and Tiukalinsk, and the strip of the Akmolinsk territory adjacent to the frontier of the government of Tobolsk.

The northernmost of the zones just described is a region where agriculture exists but sporadically. It consists of unbroken urmans or expanses of forest and swamp, for the most part wholly unsuited to tillage and brought under the plough only in narrow strips, on the margins of the larger rivers and owing their conversion to a condition fit for cultivation to their influence on the drainage. The arable lands are disposed partly on portions of the river valleys comparatively elevated, and so not subject to being drowned by the ordinary overflow of the rivers; partly on the inclined banks called u v a l s, uniting the bottom of the valley with the flat interriverine space; and partly in places where the valley is not bounded by gently sloping sides but by abrupt precipices or y a r s; in such cases the narrow strips of the plateau bordering these yars are cultivated, behind which again commence the untilled expanses of the swampy urman. As regards the soils, in the fields belonging to the first group prevail very sticky clayey soils, partly gray, slightly tinged with humus, partly black, containing from 10 to 15 per cent of this substance. The black soils present two varieties; the first is an argillaceous chernoziom upon the localities with a raised contour, the most fertile of all the soils met with in the given region. The second shows black earth upon the spots, which are depressed and suffer from an excess of moisture; it is a very poor and barren soil of a peaty character unable even to yield satisfactory crops of winter rye and only adapted to sowing oats. Upon the sloping valley sides, or uvals, soils of a more friable nature predominate, although for the most part of a clayey character, fairly rich in humus and stained dark brown, upon a reddish-yellow clayey subsoil. These soils together with the clayey chernoziom of the river valleys are reputed to be the best. Uval fields are valued the more that owing to their situation they are better secured than the others from unfavourable atmospheric influences. Finally the lands tilled along the yars on the skirts of the interriverine plateaux have a soil very poor in humus and capable of yielding harvests only by the liberal application of manure. They are partly crumbly sandy tracts in the regions nearest to the Ural with an appreciable admixture of small stones or g a l k a s, partly sour clayey soils of the type prevailing in the localities lying further to the south.

The whole central zone of the Tobolsk government presents a perfectly flat plain intersected more or less by wide valleys belonging to different rivers and streams. Like the northern zone, it has for the most part a forest character. But in contradistinction to the northern zone, forests of deciduous trees, principally birch predominate instead of conifers. Moreover, the morasses although very extensive yet here occupy much less of the total area than in the northern zone. Hence it is that in the localities situated in the middle zone not only are the river valleys suited for agricultural operations together with the bordering lands, but more or less considerable portions also of the interriverine plateaux. The lands suitable for raising grain are here at times spread over more or less extensive tracts, at others in small patches between woody or swampy lands unfitted for cultivation. The soil conditions of these forest fields are very monotonous, they are almost exclusively so-called b i e l i k s, characterised by a very thin layer of turf, a vershok or vershok and a half thick, under which lies a stratum five or six vershoks thick of almost unproductive, light-gray, sour, clayey soil, superimposed upon a reddish yellow clay. These bieliks fairly useful to the farmer when manured, without it are very illsuited to agriculture on account of their properties

and are very stingy. Cereals only derive nourishment from the superior turf layer, and when the latter becomes exhausted, which ensues after three or four crops, it is necessary to abandon the field for twenty to twenty-five and more years, until a new turf layer is formed. It is clear under these circumstances why agriculture upon soils of this kind is only capable of a feeble development. It is concentrated in the whole of the central zone along the rivers where the conditions of soil are much more favourable. It is principally the sloping uvals near the rivers that are brought under the plough; these extend in some instances along both banks, in others along one only, attaining in the case of more considerable rivers a breadth of several versts with a height above the valley of thirty to forty sagenes. The soil conditions of the uval lands show little variation; is everywhere a dark brown and clayey, pretty friable, not seldom with an admixture of large grains of quartz visible to the eye; the subsoil is reddish yellow clay. The thickness of the workable layer varies ordinarily from five to eight vershoks. The soil is the richer in vegetable mould and therefore more fertile, the greater the depth of the tillable layer. Above the uvals on the tracts of the interriverine plateau bordering on the same, the soil frequently passes into a black friable form of great thickness, 10 to 12 vershoks and more, and rich in humus, as much as 15 to 17 per cent but of little fertility, possessing an undoubted peaty character. Little ploughing is done within the river valleys, for the most part presenting meadows subject to inundation or so narrow that they leave no room for agricultural operations. Where however the valleys are tilled, tenaceous clayey soils prevail of the same types as were described in speaking of the soils of the northern zone.

But the greatest interest and the greatest variety are afforded by the soil conditions of the southern zone of the government of Tobolsk, which enters into the composition of the so-called Ishimsk steppe. The contour of this steppe is remarkable in the highest degree. On the whole absolutely level, it is scattered over with a number of lakes, between which extend small elevations, ridges or islands. Always long and narrow in horizontal section, their length sometimes reaches many versts, while their breadth at the level of the horizon is measured by hundreds of sagenes and never exceeds a verst, they always trend in the direction of their long axis from W.S.W. to E.N.E. and are not more than three to four sagenes in height. They have extremely sloping sides and are distinguished by the predominance of dark brown, friable clayey soils with a heavy admixture of white sand, upon a reddish clay subsoil. In appearance closely resembling the uval soils of the middle zone, the soils upon the islands of the Ishimsk steppe, characterized by the thriving upon them in the unploughed state of the wild cherry, are much more fertile and are particularly adapted to the raising of wheat, with which they are accordingly chiefly sown. As for the flat spaces lying between the islands, they are partly naked salt marsh, absolutely stripped of all vegetation or clothed with a typical flora such as salsola et cetera, partly feather-grass steppe over which are scattered, in scarcely perceptible hollows, spinnies of birch and aspen called «k o l k a s». The soil conditions of the two classes are absolutely different. Upon the open steppe the soil is so-called p o d s o l o n o k, that is, dark grey, very tenacious clay, covered with a thin layer of turf. In the kolkas, it is black, very deep, but at the same time very barren, with a decided peaty character.

Both the general appearance and the soil conditions of the Ishimsk steppe change a little on moving from the west to the east. Upon its western border in the Kurgansk district and the south-western part of that of Ishimsk, the islands are small, but very thickly set, so that they occupy the greater part of the expanse, and communicate to the latter a rolling character. The soil upon the islands is very darkly stained and the wild cherry, the sign of its excellent quality, is evrywhere to be met with. Further to the east, in the south-eastern corner of the Ishimsk district and in that of Tiukalinsk, the cherry vanishes, the soil on the islands has on the whole a paler tinge and is much less fertile. The islands themselves, each by itself much longer, are scattered over the steppe somewhat thinly, so that the latter here assumes rather a flat than a rolling character.

A contour very similar to that of the Ishimsk steppe is possessed by the Barabinsk steppe lying to the east of it, embracing in the Tobolsk government the eastern half of the Tiukalinsk district and in that of Tomsk, the south-western half of the Kainsk district. Here also the horizontal surface of the steppe is sprinkled on the one hand with lakes and on the other with oblong elevations, ridges or islands. Here as in the Ishimsk steppe, the dependence between the contour and the soil is so close that, as one of the latest explorers remarks, «knowing the contour of this or that site, it is easy to determine the soil itself, lying there». Upon the broad and sloping ridges chernoziom is everywhere deposited; upon the narrow and more abrupt ridges, a clayey soil. Some broad ridges possess sloping northern and more precipitous southern sides. In such cases chernoziom is to be found on the northern incline and clayey soil on the southern. As for the flat space between the ridges the more low lying plots are composed of saltmarsh, partly white or covered with a saline efflorescence and deprived of all vegatation, partly black, covered with a herbaceous growth but equally unsuited to the raising of grain. Upon the more elevated parts, lying nearest to the foot of the ridges, the soil is p o d s o l o n o k of the same type as in the Ishimsk steppe and adapted to the cultivation of cereals.

In respect to the fertility of its arable lands the Barabinsk steppe is placed in the same conditions as the eastern Ishimsk borderland, and in worse than the western part of the latter. In the Barabinsk steppe, as in the eastern part of the Ishimsk steppe, the wild cherry, characteristic of the best wheat lands of the western part of the Ishimsk steppe, does not occur. Within the Barabinsk steppe itself the general level of fertility is not without variation. Least fertile is the northern borderland of Barabinsk, where the steppe gradually passes over into an expanse of urman and swamp. Most fertile is the southern borderland, embracing a part of the Barnaul and Bisk districts and reaching to the foothills of the Altai.

From the eastern frontier of the Barabinsk steppe right up to lake Baikal, including the eastern districts of the Tomsk government and the whole cultivated portion of those of Yeniseisk and Irkutsk, stretches a tract showing great uniformity both in its general character and in its soil conditions. A certain peculiarity is presented only by the southern borderlands of the Yeniseisk and Irkutsk governments, especially the Minusinsk district, which possess a steppe character, with a predominance of chernoziom soils of good quality, yielding excellent harvests of wheat. The whole remaining space has the appearance of what may be called the central Siberian p o l e s i e or forest region.

On the south, the whole of central Siberia is bordered as is known by lofty mountain ranges, the Altai, Alatau and Sayan. But the mountain systems of these ranges fill up a locality, almost uninhabitable and in no way belonging to the composition of the cultivated zone of Siberia. Only here and there the last offshoots of the mountains having the form of small hills enter into the limits of this zone. Further the whole cultivated part of the central Siberian polesie presents, speaking generally, a typical flat elevation, and the considerable inequalities to be found upon its susface proceeded almost exclusively from the fact that the rivers have washed out in it more or less deep valleys. Where the rivers are well filled and their beds situated near to each other, there the general plain character of the locality is completely masked. Flat expanses are hardly to be seen, the whole contour is composed of the uvals bordering the river valleys, and the locality produces the impression of a hilly district, where the interriverine watersheds seem to be as it were low mountain ranges. Where the rivers are less close together and not so full, the flat character of the locality shows itself quite manifestly, and the narrow river valleys occupy only an insignificant part of the space compared with the flat watersheds. As will immediately appear, such a flat contour, on account of the soil conditions connected therewith, is much less favourable to the successful development of agriculture, than a more rolling contour.

As far as regards soil, a characteristic feature of the central Siberian forest region, at any rate of its cultivated portion, (in the taiga, tenacious gray clayey soils prevail) is the predominance of chernoziom, and in general, dark-coloured soil. At the same time, in distinction to the soils of the Tobolsk government rich in humus, the chernozioms of this locality do not possess a brownish tinge but are dyed a perfect black. As in the localities, described earlier, the character of the soil is here also in the closest dependence upon the contour. The high-quality soils with a dry land flora are situated exclusively upon spots with a high relief, affording a free drainage to the water, and consequently mainly on the uvals bordering the river valleys. Where the uvals are more gently sloping, the soil is deeper (from 6 to 8 vershoks) and richer in humus, (10 to 12 per cent). It has a perfectly black colour and while preserving its clayey character, is yet fairly friable. Both in respect to its physical qualities and the degree of abundance of nutritious substances, this soil is very favourable for the cultivation of grain and especially for rye. Where the uvals are more abrupt, the percentage of humus is less (from 5 to 6 per cent), the thickness of the soil does not exceed 4 to 6 vershoks, its colour instead of black becomes gray, the soil itself is much more tenacious, and its productiveness perceptibly lower than that of the black soils, earlier characterized. As for the flat interriverine plateaux, there black soils with a vegetable character prevail. More often tenacious, muddy, clayey soils are met with, more rarely friable soils composed of humus and peat. Notwithstanding the considerable depth (12 to 16 vershoks and more) and the richness in humus (15 to 17 per cent), the soils of both types are little adapted to the cultivation of grain. Not to speak of wheat, even rye grows badly on them, so that the lands with a vegetable soil are principally sown with oats.

It is now clear why the rolling contour of the locality in the central Siberian forest region is more suited to raising grain than the flat relief. Where slopes prevail, there black and grey soils of good quality predominate, so that in localities ploughed up in all directions by

rivers and streams, nearly the whole ground is not seldom occupied with arable land with good chernoziom soil. Where flat plateaux prevail, there soils of good quality occupy but narrow strips, bounding the banks of rivers, and there predominate partly wet lands unsuited to agriculture, partly arable lands with a bad soil, of a swampy and vegetable nature.

With this the sketch of the soil conditions of the agricultural zone of primitive Siberia may be terminated. In conclusion it is necessary to say still a few words on the soil conditions of one of the borderlands of Siberia, in reference to which more precise information exists, namely Amouria.

The three sections into which Amouria was divided above are sharply distinguished in reference to soil. Above the mouth of the Zeya and below that of the Bureya prevail dark brown, clayey soils lying on stony fundamental rocks, in some places covered with a thin turfy layer of humus, in others entirely free from a tinge of mould. In the inundated meadows of the Amour the clayey soils yield place to coarse-grained, sandy, much less fertile soils, and in the thick woods, to a sour soil with a pale gray tint in the upper layer, and a whitish in the lower. Over the expanse included between the valleys of the Zeya and Bureya the whole area as stated by Professor Korzhinsky «is composed of sandy clays fairly tenacious in the upper levels. They are covered with a layer of dark mould, having a depth of 4 to 6 vershoks on the sloping uvals, and one and a half arshines on the bottoms». Upon dry elevated places this soil in its physical properties and structure recalls the Russian chernoziom; in the lower places it is manifestly of a half-swampy origin, recalling in all respects the black vegetable soils of Western Siberia and neither in its origin nor significance in farming having anything in common with true chernoziom.

With the extraordinary variety of climatic and soil conditions and population sketched in the preceding pages, it is impossible to look for any uniformity in the methods of farming employed in Siberia and especially in the system of field culture. And in fact the systems and types of field culture and the rotations of crops are very varied.

In those of the Siberian governments which comprise the mass of the agricultural population and lands suitable for farming operations, Tobolsk, Tomsk, Yeniseisk and Irkutsk the Transbaikal territory and the cultivated portions of the Akmolinsk and Semipalatinsk, a peculiar system of agriculture prevails which is absolutely unknown in European Russia. It bears the name of the resting and fallow system. Agriculture is in this case founded exclusively upon the exploitation of the productive forces of the land, unsupported by any manuring, and renewed by the combination of two means, the abandoning of the land to waste, and the rotation of crops with fallow. The land, whether cleared from forest or ploughed up in the open steppe, is sown two or three years consecutively with grain, and then left a year in fallow. It is then sown one or two years with grain and then again goes under fallow. Such a rotation is continued until the severe falling off in yield and the choking with weeds compel the land to be abandoned to rest, and a new patch to be broken up. The land is allowed to rest until definite signs, which are well known to the peasants, show that its productiveness has been sufficiently renewed. Then it is again ploughed up and the same process is gone through from the very beginning. At the same time it may be said, as a general rule, that in the beginning of the period of cultivation and on the fallows more

exhausting grains are sown, such as wheat, winter and spring rye; towards the end of the period, and upon the stubble fields, such grains as barley and oats. Moreover, at the beginning of the period of tillage the land is more seldom left fallow; at the end, more often; thus, at first after every two crops, at last after every single crop harvested. Finally, the duration itself of the periods of tillage for freshly broken lands, that is, such as have never been under cultivation, is in general longer than for lands which have been ploughed before and again broken up after a prolonged rest, as such rest seldom completely renews the fertility of the soil.

Such is the general character of the rest and fallow system. As for its varieties, they are extremely numerous. Siberian farming is distinguished by the absence of all pedantry. Not only every volost or commune, but each farmer independently determines the rotation of crops for every patch of land which he is using, adapting himself to its soil and situation, to the climate and conditions of the market, finally, to his personal means. The number of crops taken from the land during the period of tillage fluctuates between 3 and 4, for poor sour lands, and 25 to 30 for the best chernoziom, and there even exist lands, especially in the southern part of the Tobolsk government, which have been under the plough more than 100 years and have never yet been left to rest. The duration of the period of rest varies between 5 and 10, and 25 and 30 years, depending on the one hand, upon the soil conditions, and on the other, upon the degree of exhaustion to which the land has been brought by previous sowings. In some places and on some lands, sowing on the stubble field is a normal occurrence, so that the rotation of crops approaches the rest-three-field type; in other places and upon other lands such sowings form an exception, or are not carried out at all; the land is fallowed after each crop and the rotation approximates to the rest-two-field type, and so on. As to the predominating sorts, in each locality the more exacting grains are to be found on the best lands, and the coarser kinds on the worst. But however this may be, whole districts are characterized by the prevalence now of one, now of another kind of grain. Thus upon the splendid sandy chernoziom of the steppes of the south-western part of the Tobolsk government, and of the agricultural localities of the Akmolinsk territory, as also in the Altai mining district and the southern part of the Yenisei government, wheat predominates, in some places occupying as much as half of the whole area sown, and more. In the central agricultural part of the Tobolsk government, distinguished by the prevalence of sourish soils, the crops are mainly barley and spring rye. Over the whole expanse from Tomsk to Irkutsk the forests and friable chernoziom soils favour winter rye, which only yields place to spring rye in the places stripped of forest. Along the whole line of the Siberian tract the largest areas are sown with oats, which here have a certain and profitable sale. Besides the cereals enumerated, there are further sown here and there, millet, buckwheat, peas and potatoes, while of the industrial plants flax is almost universally sown, hemp in the chernoziom localities, and sunflower in the Altai.

The system of agriculture prevalent in Siberia exhibits the greatest variety not only in space, but in time. With the growing density of the population and the contraction of the land space, the periods of rest of the land are gradually reduced, and the periods of tillage increased. The rapidly progressive exhaustion of the land, resulting from this, it is attempted

to arrest by more frequent fallow, the rest-three field rotation is gradually abandoned for a rest-two-field. At the same time the exhaustion of the land makes it ever less capable of yielding satisfactory harvests of the more valuable grains and compels their replacement by coarser kinds. Wheat and, where the forest has been most cut, winter rye, are expelled by spring rye; the latter, by barley. At the same time the lowering of the crops gradually brings the population to the conviction of the impossibility, under the changed conditions, of carrying on farming in the old way and of the necessity of passing to new methods, namely with the use of manure. Part of the population however does not wish to reconcile itself to this necessity and prefers to leave for new places, where there is still plenty of land and where its freshness permits farming by the customary rest method. The other part, the majority, remains and continues in spite of everything to carry on the old methods. Finally, the more energetic minority begins by degrees to pass over to the manuring system. As first individual faint-hearted and frequently unsuccessful attempts at manuring the land find more and more imitators, and little by little agriculture with manure from being a rare exception becomes the general rule.

Some localities of Siberia, in the main, the northern borderland of the agricultural zone of the Tobolsk government, that is, the Turinsk district and the middle of the Tobolsk district, have already passed through that critical period. In these localities, in some places as regards all the lands under the plough, in others as regards only those nearest to the farmsteads, this system has become firmly established. It is precisely of the form of the three-field system as it has long existed in the central governments of European Russia, that is, with a predominance of rye in the winter field, oats and barley in the spring, and with green fallow. As for the manuring, the extent to which it is carried is very different, in dependence on the relation of the quantity of meadow land to that of the land under crops. In the comparatively southern localities, where there is a fairly large amount of arable land, and few meadows, a part of the fallow field, equivalent to $^1/_6$ to $^1/_2$, is manured. Further to the north where there is very little arable land, and much meadow land, the whole fallow field is manured, and as a consequence in spite of the comparatively unfavourable natural conditions, larger and, what is particularly important, more constant crops are obtained than anywhere in Siberia. Finally, still further to the north near the 60th parallel, at the very northernmost limit of agriculture, even a heavy application of manure does not make it possible to carry on the three-field system. Here two fields are used, with winter rye predominating on the best lands, and barley on the rest. With heavy manuring agriculture even here yields excellent results, but is incapable of attaining any considerable development, in consequence of the extremely limited supply of lands suitable for sowing grain.

The cultivation of the arable lands in Siberia is on the whole very satisfactory, far better than on the peasant farms in central Russia. Such a superiority of the Siberian peasant farming is determined mainly by the abundance there of working cattle, possible on account of the wealth of the country in hayland and pasture, and secondly of the comparatively good construction of the agricultural implements.

The implements used in Siberia for ploughing, to wit, ploughs, here bear various names, k o l e s i a n k a, s a b a n, rogaliukha, et cetera; but their fundamental construction is

everywhere the same. They consist of a broad triangular ploughshare (more often made in two parts) whose left angle is bent forward and plays the part of the web, a wooden mouldboard, a lifting screw or a system of wedges regulating the depth of ploughing. The work of this plough has no resemblance to that of the Great Russia plough (sokha) but is very like that of the plug. The depth ploughed may he carried to four and even six vershoks, the breadth of the clod being also six vershoks. The latter is cut off very cleanly and a field ploughed by a Siberian sokha hardly differs in appearance from one ploughed by a plug. In the regions where agriculture is most developed the sokha is fastened to a two-wheeled carriage and furnished with two or three horses. In localities lying near to the northern limit of agriculture, the shafts are fastened directly to the mouldboard and the plough is harnessed to one horse. The harrows used in Siberia belong to the half-heavy type. Thy consist of a wooden frame with iron teeth, in number from 16 to 20. In the purely agricultural zone of Siberia, the average farmer harrows with three harrows, while the rich farmers send one after another up to six. In the north, where the strips are not large, usually one harrow is used, but they here have very many more teeth. The other implements, sickles, scythes, both simple and with fingers (cradles), flails for thrashing, shovels for winnowing, present no differences from those employed in European Russia. Until lately there were no machines in Siberia. Recently small hand winnowers of the Grant system have been largely adopted in the Altai and in localities lying to the east of Tomsk, and horse thrashing-machines have begun to appear among the rich peasants.

The chief object that the Siberian peasant places before himself in preparing the land for sowing is the struggle with weeds, which with the freshness of the soils and their richness in organic substances grow up in great abundance and are one of the worst enemies of grain crops. Another problem, the bringing of the soil into the requisite condition of friableness, in the mind of the Siberian peasant, yields to that of destroying the weeds. The degree of their abundance mainly determines in each case the greater or less extent of ploughing and harrowing, the time for these processes and for sowing and a mass of other less essential details.

The normal type of the cultivation of fallow in Siberia is twice ploughing, with harrowing after the first. All these operations are carried out in the interval of time between the beginning of June and the end of July. An additional third ploughing is added in the case of many weeds or heavy soil, especially if the later has been washed with snow water and threatens to become covered with an impenatrable hard crust. Upon such heavy, clay soils the third ploughing of the fallow is effected in spring, upon friable soils in late autumn. Stubble fields are ploughed once only, usually in spring, and only rarely on very crumbly soils in autumn. Before ploughing the remaining stubble is burnt and the ash serves in some sort as a manure. The sowing of winter grain begins from the very last days of July and where possible is concluded in the middle of August, although in the case of poor men it not seldom drags on to the beginning of September. The spring grains in the southern localities of agricultural Siberia are begun to be sown at the end of April, in the northern regions, in the beginning of May, wheat being sown earliest of all, and latest oats and especially barley. The time of sowing has on account of the Siberian climatic conditions a very

great importance. With too early sowing the grain suffers from spring frosts; with too late, from weeds and autumn hoar frosts. A day's difference in the time of sowing often determines a good or a bad harvest.

The field once sown is not attended to any more. Only young spring crops, in the main wheat and spring rye, have to be very frequently weeded, as often neither ploughing nor harrowing are capable of stopping the growth of weeds. The harvesting of winter grain begins ordinarily at the end of July; of spring, at the beginning of August. The harvesting of all grains is concluded under ordinary circumstances at the beginning of September, but when the weather is unfavourable, is frequently delayed much later, sometimes to the beginning of October. The grain, cut with sickle or scythe, after drying is gathered into heaps on the field and on the arrival of winter is carried on sledges into the farmsteads or to the zaimkas. It is then kiln-dried in out-houses or barns, thrashed and winnowed. Next the grain intended for sowing is subjected to a final cleansing by means of special instruments, so-called podsievs, cylinders turning about a horizontal axis, made of sheet iron with holes of various sizes. That which is intended for food or sale is subjected to no further treatment.

It is impossible to give any data on the cost of production of grain, in consequence of the considerable variety in the level and the violent fluctuations in wages, which should apply to the whole of Siberia or even to its agricultural region only. The cost of separate operations and of the whole together, in the production of grain whether per dessiatine or per poud in different localities presents very wide variations. The figures below, showing the cost in some parts of agricultural Siberia of the more important operations in the raising of grain, may give some idea thereof.

Per dessiatine.	Southern part of Tobolsk. Best localities.	Southern part of Tobolsk. Worst localities.	Central Tomsk.	Agricultural parts of Irkutsk.
	Roubles.			
Ploughing (once)	2.00	1.25	2.00	2.00
Harrowing »	1.20	0.75	1.00	1.00
Reaping } average crop.	7.50	3.75	7.00	6 to 10
Thrashing } average crop.	4.50	2.00	4.00	4.00

The entire cost of the cultivation of a dessiatine of land together with the harvesting of the crop and the cleansing of the grain is expressed for the same localities by the following figures:

	Fallow.	Stubble.
Best localities } southern Tobolsk	23 — 27 roubles	14 — 18 roubles
Worst » } southern Tobolsk	15 — 20 »	8 — 9 »
Central Tomsk	22 — 27 »	13 — 15 »
Irkutsk	25 — 27 »	14 »

Thus 22 to 25 roubles per dessiatine for spring grain, sown on fallow, and 12 to 15 roubles per dessiatine on stubble field, are the approximate standards, around which the entire cost of the production of grain in agricultural Siberia fluctuates, and in particular in such parts of it where farming is carried on according to the rest-fallow system. In those localities of the Tobolsk government, where the passage has already been effected to farming with manure and a necessary three-field or two-field rotation of crops, the total cost of the operations per dessiatine is as follows:

Three-field region with manuring of part of fallow	32 to 34	roubles	2 grain crops in rotation.
» » » » » » whole » »	43	»	
» » »	19 to 20	»	per crop.

Before passing to the question of the yield, it is necessary to say a few words on the thickness of sowing. Here, as in what has preceded, it is impossible to cite any figures having an application to the whole of Siberia. The thickness of sowing per dessiatine in different localities varies as follows:

For winter rye between	6 — 7	and	14 — 16	chetveriks.
» spring » »	5 — 7	»	11 — 12	»
» » wheat »	6 — 8	»	14 — 16	»
» oats » »	12 — 16	»	28 — 32	»
» barley » »	8 — 12	»	20 — 24	»

But the lowest of these figures now are very rarely met with, namely only upon freshly cleared, very fertile lands. The highest refer exclusively to the northern border land of agriculture, to localities with two-field farming, and also three-field with manuring of the whole of the fallow. In the case of the region of greatest development of agriculture the limits of variation are much narrower. The amount sown per dessiatine is ordinarily:

Rye, winter and spring	from	8	to	10	chetveriks.
Wheat.	»	10	»	12	»
Barley.	»	12	»	14	»
Oats.	»	16	»	20	»

The sowing is the thinner the more southern the locality; the better and fresher the soil, the earlier the given land is sown; it is, on the contrary, the thicker, the further to the north, the more the land is exhausted and the poorer in organic matter. A mistake in the thickness of the sowing threatens the farmer with very lamentable consequences. If the sowing has been carried out too thinly, the young plants are threatened with danger from weeds; if too thickly, with a rich soil and moist weather, the grain may easily over tiller and the ears fill badly.

The extremely treacherous nature of the harvests, their violent fluctuations from very high figures to zero, form an important and characteristic feature of Siberian agricultural economy. An exception is only formed by the localities lying near the northern limit of agriculture, those localities where the transition has already been accomplished to manuring and the three or two-field system. Thanks to the influence of manure and the treading of the fallow

field by cattle, and also to the favourable natural conditions, the absence of droughts and hailstorms et cetera, complete crop failures here hardly ever occur, and in general very bad harvests are rare. Not often rising very high, the harvests ordinarily keep near the average standard, which is here very fair. In localities where part of the fallow field is manured the average yield of rye fluctuates between 70 and 80 pouds per dessiatine, only on the very worst fields falling to 60 pouds. The yields for oats and barley vary within about the same limits. Further to the north where the whole fallow field is manured, rye gives on an average 80, oats and barley, from 90 to 100 pouds per dessiatine. On the region of two-field farming the yields of rye also flactuate from 70 to 80 pouds, but spring crops give considerably more. Oats give on an average 110 to 120, barley 100 or 110 pouds per dessiatine. Thanks to such high yields the population of some localities of the Tobolsk government, lying near the very northernmost limit of husbandry, lives notwithstanding the insignificant extent of the arable land, on its own grain.

Very different is the case in localities where the rest-system still prevails. The average figures of the productivity are here also fairly, and in some places, very satisfactory. Thus, the average figures of the harvests for wheat fluctuate in the above indicated wheat regions between 60 and 80 pouds, and only where wheat reaches its extreme northern limits, or encounters unfavourable conditions of soil, fall to 50, 40 pouds and lower. Winter rye in localities abounding in forest and having suitable soils, gives on an average also from 60 to 80, sometimes even as much as 90 pouds per dessiatine, and only on the very worst soils does the average yield sink from 40 to 50 pouds. Such are also the limits of fluctuation and the average figure for the yield of spring rye in the localities where it is most grown. As for oats, two figures representing the average yield must be noted: when sown on fallow, and when sown on stubble fields. In the first case oats, even upon comparatively bad lands, yield on an average not less than 80 to 100 pouds per dessiatine. When the sowing is on stubble, even the best lands do not reach this average standard, while bad lands yield not more than 40 to 50 pouds per dessiatine. Finally, barley in the region of the rest-system of farming is only sown on bad and exhausted lands, where it gives better crops than any other breadstuff. Where rye either does not grow at all, or yields some 30 to 40 pouds per dessiatine, barley with an average harvest gives 50 to 60 pouds.

But the figures quoted are far from affording material for drawing true conclusions in reference to the economical position of the Siberian agriculturist. The extremely violent and wide fluctuations deprive these averages of almost all significance. The upper limits of these fluctuations are very high, 180, 200, 240 pouds of wheat, 180 to 200 pouds of rye, 200 to 250 pouds of barley, 250 to 350 pouds of oats per dessiatine; such yields without irrigation or manuring have excited the wonder of travellers and created for Siberia the reputation of a country of fabulous fertility. But such harvests occur once in several dozen years, and then only upon the lands which are best in respect to conditions of climate and freshness. Of course, a much less yield, 100 or 120 pouds of wheat or rye, 150 to 180 pouds of oats, and so on is sufficient to enrich the argiculturist. Such harvests formerly happened pretty often, and it was they that created the prosperity of the Siberian peasant farmer. During the last decades there have been not seldom more or less complete crop failures.

This is, be it remembered, true only as regards spring crops. The yields of winter rye in places suited to it never fall to zero; a complete failure only occurs on separate strips, and therefore bad harvests in the forest rye region, lying to the east of Tomsk, never place the population in such a difficult position, as in the region of spring crops, and particularly in the wheat steppes. Here occur complete failures, and very bad harvests not unfrequently follow each other three and four years running.

The chief causes of the failure of the crops in these steppe localities are drought and the kobylka, an insect belonging to the order of orthoptera, similar to the locust and applied to several species of grasshopper. In forest localities these causes yield place to the baneful consequences of unfavourable winters, which react destructively upon the winter crops, but these circumstances never here attain such a character as the droughts in the steppe localities. Not less essential causes of crop failures, operating equally in the forests and steppes, are the spring frosts and autumn hoar frosts, of which the former damage the sprouting grain the latter injure it when filling. According to the soil, situation and time of sowing, the hoar frosts and frosts sometimes destroy the grain without leaving anything, sometimes destroy or spoil only part of the crop. The influence of frosts is different in different localities. In some they injure the crops once in several years, in others, much more frequently. There are even spots, as to the north-east of Tomsk, where the spring crops freeze every year. Oats in such places are sown for straw and feed; the seeds are always brought from without. Further mention must be made of the fogs and especially of the appearance of microscopic fungi, such as smut and ergot. At times, continuous rains prevent the grain from ripening and hinder harvest operations; at others hail, laying the crop, are the cause of failure.

It is stated above that in localities forming part of the zone where the rest-system is practised agriculture is, if not the only at any rate, an essential source of the peaple's prosperity, and the sale of the surplus produce, the principal source of its money income. Such grain surplus finds a market in different directions. The wheat from the Altai, the steppe regions, and the southern part of the Tobolsk government, goes partly in a raw state, partly in meal, to the west, namely to European Russia. Nearly the whole of the surplus of oats is consumed by the great Siberian tract. The same traffic over the tract swallows up a considerable part of the grain produced in its neighbourhood. Lastly a large part of the grain surplus of the agricultural region contributes to the food supply of the population of the non-agricultural borderlands of Siberia, or is bought up by the gold mines for the needs of their miners. There still remains a large quantity which goes to the distilleries to be converted into spirits. All these outlets for the grain produce, in spite of their apparent variety, have one common feature, namely they all absorb the surplus from good harvests and do not return it when there is a crop failure.

Siberia does not yet possess a properly organized local grain trade, capable of equalizing surplus and deficit according to good and bad seasons, and regularizing the prices of grain. Neither does there exist such a regulator of the fluctuations in harvests and prices according to locality. In consequence of the immensity of the distances in Siberia and the insufficiency of the ways of communication grain, grown in abundance for example, in the Yenisei and even Tomsk governments, cannot supply the deficit

in that of Tobolsk. The cost of carriage would be too great, and accordingly extreme want may be experienced in one government simultaneously with an extraordinary surplus in another. Add to this the complete absence of organized credit in Siberia, whether for general purposes or in reference to grain, and the fact that the peasant makes his chief outlays in autumn when grain is cheap, while in years of scarcity he must buy it in spring when it is dear, it follows that the peasant is obliged to throw the more grain on the market the cheaper it is, and to buy in proportion to its dearness. From all this results one more charateristic feature of Siberian farming, the extraordinary want of fixity in the prices of grain, rising in times of scarcity higher than anywhere in European Russia, and falling in good years to an extremely low level.

In the sketch made in the preceding pages of the position of agricultural production, original Siberia, or the four governments with the adjacent territories of Yakutsk and Transbaikalia to the east, were mainly in view. Of the two last-named territories the former, as far as the beginnings of agriculture exist there, presents a complete agreement with the parts of the Tobolsk government adjacent to the northern boundary of grain raising. Transbaikalia with insignificant differences resulting from its more steppe like character and better climate, approaches the conditions of the conterminous Irkutsk government. No special account is required of the conditions of agriculture in those districts of the territories of Akmolinsk and Semipalatinsk where grain is raised without artificial irrigation; they present complete accordance with the conditions obtaining in the wheat regions of the Siberian governments, with but one difference, that the lands are here fresher, and therefore their yield is higher and crop failures occur more seldom.

To complete the picture of agriculture it is however necessary to add a few words on its position in localities where it is placed in conditions absolutely different from those described above, in the Zaisan district of the Semipalatinsk territory and in Semirechia, as well as in the Amour-Ussuri region.

Alike in the Zaisan district and Semirechia, agriculture, as was indicated above, is only possible with artificial irrigation. The fields are here intersected by great irrigating ditches, a r y k s, from which when ploughing, little runlets are led in all directions by the s o k h a, thus distributing the moisture equally over the whole field. In the Zaisan district the irrigated fields are sometimes also manured, and the water is let on first before ploughing, and then, during the growth of the plant, according to the weather, from twice to four times more. As a rule the crops are watered first thirty days after sowing, again fifteen days later, and a third time after the lapse of forty days more. After eight crops the field requires either a three years rest or manuring. During the whole eight years however it is sown with one and the same kind of grain, wheat, rye, millet or oats. An alternation of crops, and even a mere change to another kind of grain, are not practised here, because the seed, falling during the operation of harvesting, springs up and would only spoil the next crop. In the Semirechensk territory, the irrigated land in consequence of the hot climate yields two crops a year; the winter field sown with wheat and barley ripens at the end of May, and when harvested is sown with a second crop m a s h, a small pea, millet or carrot, more rarely k u n z h u t, poppy or lentil. The second crops ripen and are removed in the autumn of the

same year. Then the field is sown for the next spring with spring plants, mainly rice and sorghum, and also in small quantities, cotton and lucerne. The harvests in the irrigated lands both of Semipalatinsk and Semirechensk produce very heavy yields, and crop failure are unknown. The grain raised on the irrigated lands not only suffices for the uses of the farmers, but a portion of it goes for sale to China and the nearest Kirghiz nomads.

In the Amour territory a strict distinction must be made between the farming of the Russian population, peasant and Cossack, and that of the natives, Coreans and Manchurians. The Russians practise an extremely extensive system of farming, the newly cleared arable land is ploughed over several times during a whole year, and is then annually sown with grain without fallow or manure until it is completely exhausted. The best clayey soils thus are made to yield as many as fifteen crops, one after another, poor soils not more than seven or eight. During the first years after the clearing, wheat or spring rye is sown, next a passage is made to oats, and then for a year or two, buckwheat. After the last, a crop which somewhat reestablishes the fertility of the soil, they again sow wheat or spring rye, followed by oats, until the latter ceases to produce satisfactory crops. Fields once abandoned are very seldom ploughed up afresh, although they might after a rest yield very fair crops. It is the custom to break up, almost exclusively, fresh hitherto untouched lands, of which up till now, on account of the recent settlement of the country, there is no lack. The yields of grain are in a quantitative respect very high, but the quality of the Amour grain is far from satisfactory. The excess of moisture prevents the regular ripening of the grain, which is dark, of light weight and of low nutritive value.

The same character on the whole attaches to Russian agriculture in the Ussuri region except that in order to avoid soaking, sowing is here carried on in rows in the form of small ridges, the furrows remaining between them serving as drains and for ventilation.

As far as concerns the Coreans and Manchurians living in Amouria their farming, in opposition to the Russian, is distinguished by great intensiveness. The size of the cultivated plots is not great, but on the other hand the fields are most carefully tilled, the sowing is in rows by hand or machine; the young plants are weeded several times during the summer, so that weeds are hardly to be seen on the fields of the Coreans and Manchurians. while they are such a dangerous enemy of the crops of the Russian population. The chief crop among the Coreans and Manchurians is b u d a (setaria Italica); next follow various other cereals and garden plants; buda is also their chief food. An expenditure of eighteen to twenty pounds of seed on a dessiatine gives one hundred and fifty to two hundred pouds or more, so that the yield of one dessiatine provides a whole family for a year, or a year and a half.

Having finished the description of the principal systems of agriculture existing in Siberia, it is necessary to proceed to the consideration of the statistics of its present position. «The Chernoziom constitutes», says Brehm «the true gold of Siberia». And in fact agriculture is now the chief and safest occupation of the settled Siberian, and in it consists the whole future of the country. It may be assumed that from the whole territory of Siberia there is, on an average, harvested about 160,000,000 pouds of various grains, of which approximately 20 per cent fall to Tobolsk and Tomsk, as the most densely populated, 12 to 15 per cent to Yeniseisk and Irkutsk and Semirechia, 3 to 5 per cent to each of the territories of Semi-

palatinsk, Akmolinsk and Transbaikalia. The remainder is divided between Yakutsk, the Littoral and the Amour territories. As regards the two latter territories and certain localities of steppe regions it must be observed that, thanks to successful colonization, the agricultural productivity of these localities has latterly grown extraordinarily rapidly, and that there is no doubt but that in the near future they will occupy a very prominent place in the ranks of grain producing countries. Turning to the kind of grain cultivated in Siberia, it must be observed that about 60 per cent of the whole production consists of spring wheat and oats, about 20 per cent winter rye, while the remaining 20 per cent represents all other kinds of grain.

The instability of the prices is the most striking feature, as also the uncertainty of the harvests, in the wheat area, and this is particularly the case in the southern part of the Tobolsk government. The average prices for this locality are as follows:

Rye in kernel	20 — 25 kopecks per poud
Wheat	50 — 60 » » »
Oats	1.20 — 1.30 roubles per chetvert or 20 — 22 kopecks per poud

The minimum price to which rye has fallen during the last 20 years was 8 to 10 kopecks a poud; the maximum limit, in 1870, 80 kopecks to 1.20 roubles; in 1884, 1.50 roubles, and 1892, over 2 roubles per poud. The rapid change of prices may be seen for example from the fact that between the autumn of 1887 and that of 1888 the price of rye in the southern part of Tobolsk enhanced almost fivefold, namely from 12 to 15 kopecks to 60 to 70 kopecks per poud. In localities situated to the east of Tomsk, which sow for the most part rye, the fluctuations of grain prices, as also those of the harvests, are somewhat less severe. The average grain prices rise in moving from west to east. Thus, in the north-eastern part of the government of Tomsk the prices during a twenty-five years period were as follows:

Rye flour. . . .	48 kopecks per poud
Wheat flour. . .	76 » » »
Oats	41 » » »

In the Irkutsk government the standard average prices for the last seven years were:

Rye flour about.	1. 20 roubles per poud
Wheat »	1. 90 » » »
Oats	1. 10 » » »

The fluctuations for the Tomsk market during the last twenty-five years fall between the following limits:

	Maximum.	Minimum.	Ratio of max. to min.
Rye flour. . .	1. 45 roubles	23 kopecks	6. 3
Wheat » . . .	1. 80 »	30 »	6. 0
Oats	1. 10 »	17 »	6. 5

Thus, the fluctuations in the prices of grain in the Tomsk government although considerable are far from reaching the intensity attained by the fluctuations in the wheat localities of the Tobolsk government. In the agricultural governments of Eastern Siberia the fluctuations in prices exhibit approximately the same character. In such localities of the Tobolsk government, where farming with the application of manure has already become established, the prices and harvests are distinguished by great stability, which naturally has a very good influence upon the prosperity of the population. Thus, at the extreme northern boundary of agricultural operations in the Tobolsk government the prices for grain during the last ten years were:

	Maximum.	Minimum.	Average.
Per poud of rye flour. . . .	1.30 roubles	55 k.	80 k.
» » » oats	1.00 »	40 k.	55 k.

Thus the maximum price exceeds here the minimum $2^1/_2$ times. Independently of the fluctuating movement, the prices of grain in all the agricultural localities of Siberia have further a tendency to rise, which is explained among other causes by the expansion of the sale of Siberian grain for distilling and export to European Russia. The prices of the Tomsk market may give a perfectly clear idea of this rise. These prices, during a twenty years period, taken for each five years, give the following increasing series:

Years:	Average price per poud.		
	Rye flour.	Wheat flour.	Oats.
Five years . . . . . . 1870—1874	31 k.	66 k.	33 k.
» » . . . . . . 1875—1879	32 »	54 »	34 »
» » . . . . . . 1880—1884	58 »	86 »	43 »
» » . . . . . . 1885—1889	60 »	88 »	44 »

In proportion to the progress made by the works on the Siberian railway, the rise in the prices for grain in the agricultural regions will doubtless proceed still faster.

Live Stock Industry.

Cattle raising in the localities containing the main mass of the Siberian population, that is, in the whole agricultural tract of Siberia, plays only a secondary part in the economical life of the population. Its dimensions and relative importance change in dependence mainly upon the relation between the quantity and quality of arable lands, on the one hand, and of the lands adapted to the purpose, namely meadows and pastures, on the other. Siberia is on the whole very rich both in meadows and pastures, although the low nutritive value of forest herbage makes it necessary in the greater part of Siberia to expend much more hay and grazing space upon rearing cattle than is required under similar circumstances in European Russia. Siberia nevertheless is capable of sustaining much more cattle than it does at

present. But as the main mass of peasant labour is expended upon agriculture, cattle breeding actually attains large dimensions only where there exsists, on the one hand, an abundance of meadows and pastures, and on the other hand, the lack of arable land liberates in summer time the greater part of the working capacity of the peasantry, and where at the same time the bad quality of the ploughed land forces the peasants to seek some supplementary source of existence. Thus, in the Tobolsk government cattle raising is especially developed in the steppe localities of the Tiukalinsk district, in the Tomsk government, in the steppes of the Kainsk district and in the Chulym part of the Tomsk district, all of them being localities where agriculture is placed in comparatively bad conditions. But in these places even the importance of cattle breeding can nowhere be placed above that of agriculture. The latter still yields the main support of existence, it feeds the population, while cattle breeding only serves to satisfy its comparatively secondary necessities, and to make good those deficits which appear in the peasant economy in consequence of bad harvests.

The extent of live stock breeding is very various both for whole locatities and for individual homesteads. There are well to do farmers who have from 10 to 15 farm horses, 25 to 30 head of large-horned cattle, 40 to 50 sheep. There are again wealthy men who have 40 to 50 horses and a hundred or more head of cattle. Finally, some men are so poor that they possess either no live stock at all, or only one horse or a cow. Turning then to averages it appears that there are volosts where the household, leaving out of account young animals, owns 5 or 6 farm horses, 5 to 6 cows, and 15 to 20 sheep. Others again on an average per household have not more than two horses, one cow and 3 or 4 sheep, or even less. Summing up for the whole agricultural tract of Siberia, the standard allowance of live stock per household may be taken at 3 to 4 working horses, 2 to 3 milch cows, with the corresponding number of young cattle, and 6 to 8 sheep.

Horses in the agricultural tract of Siberia are kept mainly for farm work, but in many localities besides this for the conveyance of goods. Upon the tract a considerable part of the horses are kept specially for the passenger traffic, the post et cetera. The Siberian horse is on the whole small, is easily satisfied as regards food and water, and supports alike heat and cold. He is fast but not strong, so that the normal load of the ordinary peasant horse on a good road does not exceed 20 to 25 pouds. Only the better sort of dray horses draw 28 to 30 pouds and for short distances, 35 pouds. The types of horses in different localities of Siberia are not uniform. Thus, in the southern steppe portion of the Tobolsk government the horses are a cross with the steppe or Kirghiz strain, and are distinguished by extraordinary speed and staying powers. In the region around Tomsk the horses are somewhat bigger and do not possess the speed of the steppe or Kirghiz breed, but are on the other hand, very good for heavy draught and farm work, for which the Tomsk horses are famous and fetch a high price over all Eastern Siberia and Amouria. The Transbaikal horse on the other hand, is short and thin and is not distinguished either by its pace or capacity for draught. The prices of horses are everywhere subject to wide fluctuations. In the steppe districts of the Tobolsk government and in the localities of the Tomsk government remote from the tract, the average peasant horse is not worth more than 12 to 15 roubles. In the northern districts of the Tobolsk government and in the tract localities of that of Tomsk, it fetches

20 to 25 roubles. A horse fit for post service costs in either government 50 to 60 roubles. In Eastern Siberia horses are considerably dearer; in the Irkutsk government the average price of a working horse is not less than 35 to 40 roubles; on the Amour a small Transbaikal horse fetches from 50 to 80, and a Tomsk horse, 100 to 150 roubles.

The horned cattle over all Siberia belong to the ordinary Russian breed. They are small; a full-grown cow has a carcass weighing $5^1/_2$ to 7 pouds, rather lean and gives little milk. In summer, on usual feed, a cow gives about $^1/_4$ to $^3/_8$ vedro, and only when fed on oil cake, from $^1/_2$ to $^5/_8$ of a vedro. In winter, the yield is much less and does not on an average exceed $^1/_8$ vedro a day. Most of the milk obtained from the cows, as well as such products as curds and buttermilk, are used by the peasants at home, and only localities near the towns sell their milk. On the contrary, butter forming an important article of Siberian export is sold from every household possessing more than one or two cows. Here too the butter does not all go to market; the greater part is consumed by the peasants, only the surplus being offered for sale. The quantity sold therefore depends not only on the number of cows, but on the composition of the family. Taking the average family as containing 5 to 6 members, it can with two to three cows, in the localities most favourable to cattle raising in the agricultural zone, sell not more than 10 to 15 pounds per cow; with 5 to 7 cows, 25 to 30 pounds; with 8 to 10 cows, a poud for each milch cow or somewhat more. The butter is made from sour cream. It is not sold in the fresh state but salted down and kept till certain dates, occurring once or twice in the year, when it is bought up by factors who supply it to large merchants who melt it down and clarify it.

The sale of milk and dairy produce has a prime importance for the peasant only in a few localities, principally in the neighbourhood of towns or in the steppes. For the most part horned cattle are kept for slaughter. The meat is consumed mostly by the peasants themselves, only a small quantity being sold in the towns; the tallow and hides are as a rule sold; they go from Western Siberian to European Russia, while a considerable proportion of the hides from Eastern Siberia, of which come from Transbaikalia alone 150,000 skins a year, is used to cover tea boxes.

Dairy farming, and even so very badly organized, is carried on only by peasants in the neighbourhood of the more important towns, Tomsk, Irkutsk, and a few others. Perhaps the most important source of revenue from cattle is the sale of the live beasts, the more well to do peasants selling them at a later age than their poorer brethren. The cattle are bought up by a special class of traders, who slaughter them and either sell the produce in the towns or export the same to European Russia.

The average prices for cattle for some parts of Siberia appear in the following table.

Regions.	Cows.	Bullocks, 3 yrs.	Bullocks, $1^1/_2$ yrs.
	Roubles.		
Southern part of Tobolsk gov.	9—12	6—8	3—4
Middle » » » »	10—12	7—9	4—5
Tomsk gov. near capital and on the tract	12—15	—	5—7
Remote parts of Tomsk gov.	10—12	8—9	4—5
Irkutsk government	25—30	20—25	5—10

Cattle, like horses, become dearer the further east. At the same time the prices are subject to extremely sharp fluctuations in dependence upon the harvest and the cattle plague. When there is a bad harvest the poor farmer sells his cattle to make up the deficit in his commissariat. On the approach of an epidemie all try to sell their cattle, preferring to do so even for a song than to risk the plague. In both cases a quantity of cattle is thrown upon the market, and the prices fall to almost half, in order to rise more or less considerably after the first good harvest, or after the subsidence of the plague.

The sheep bred in agricultural Siberia belong for the most part to a very bad breed. They yield little meat; a three-year old sheep gives a carcass of 30 to 40 pounds, very little tallow, and wool of inferior quality and of small quantity, namely from 25 to 40 pounds per ten sheep. The produce of sheep farming is almost entirely consumed by the peasant at home. The best breeds of sheep are raised, on the one band, on the southern borderlands of the governments of Tobolsk and Tomsk, adjacent to the Kirghiz steppe, and on the other, in the Minusinsk region and in Transbaikalia. In the former a considerable part of the sheep belong to the Kirghiz Kurdiuk or fat-tailed breed, kept for its tallow; a yearling yields 20 pounds, a three-year old, a poud or more; in the latter place a degenerated race of merinos is bred chiefly for its wool.

Cattle breeding, although as already remarked only a secondary source of the prosperity of agricultural Siberia, affords an essential help in bad years. A terrible calamity for the people, hardly less so than a bad harvest, is the plague, whether the Siberian or chuma. Both forms of disease are particularly destinctive in the Barabinsk steppe and the localities adjacent to the Kirghiz steppe, which are the chief foci of the Siberian plague for the whole of Western Siberia. The propagation of epizootic diseases is here facilitated by the careless treatment of the cattle, although they are on the whole very well fed. The standard feed in the majority of places in agricultural Siberia is 150 to 200 and more pouds of hay per working horse with an addition of 10 to 15 pouds of oats, 50 to 100 pouds of hay with a corresponding quantity of straw per cow, and 25 pouds of hay per sheep.

For the Kirghiz of the steppe regions and in part for the Transbaikal Buriats, cattle raising is no longer a secondary but the chief source of livelihood. In the steppes, horses and sheep are the principal live stock, there being but few cattle. The horses are bred for transport and for food in the form of meat and kumys, and for sale to the neighbouring settled population, sheep for slaughter for their meat and tallow, of which the steppe variety produces a large quantity. The surplus flocks are sold alive to cattle drivers who take them to the tallow works, where they are slaughtered. The Kirghiz also keep camels which they employ in summer as beasts of burden and in winter harness to common peasant sledges.

The Kirghiz scarcely prepare any hay for winter, but leave the cattle to wander over the snow-clad steppe and pick up whatever food they can. When the snow is soft and does not lie thick, large cattle easily dig down to the dry herbage, and are then followed by the sheep. But when the first snows are succeeded by rain and then by frosts, and the ground is covered with a crust of hard ice, a consequence of such a glazed frost is a lack of fodder during the continuance of which tens and hundreds of thousands of large and especially small

cattle perish. No small number also perish from blizzards or b u r a n s, lasting in the steppes several days in succession. Herds of horses and flocks of sheep caught by the storm are unable to stand against the force of the wind. Driven in the direction taken by the blizzard they fall into gullies and ravines covered up with snow and there perish in masses.

In the northern uncultivated borderland of Siberia the wandering native population keep reindeer and harness dogs. The former are indispensable companions of the wandering native. The extreme indifference in the matter of food allows of their being kept in places where no other domestic animals could live, and their services to man are most various. As long as the reindeer is alive he is a beast of draught; killed, his flesh goes as food, his skin furnishes warm clothing, and his sinews yield thread.

CHAPTER VIII.

The forest wealth of Siberia.

The area occupied by forest; the division of the forests into zones; the northern zone of tall conifers and its boundaries; the prevailing kinds of trees; the birch zone and its limits; the importance of this zone for the agriculture and economy of the inhabitants; the zone of mountain forests and its significance; causes serving as an obstacle to the introduction of forestry into Siberia; measures of the Government for the regulating of the forests of Western Siberia; establishment of a Forest Administration; results attained in a short time; the position of forest husbandry in Eastern Siberia; measures for ascertaining Crown forests in the Amour region.

SIBERIA belongs to the number of countries abounding in forests. In Western Siberia alone the area of forests belonging to the Crown is estimated at 110,000,000 dessiatines. In Eastern Siberia the area so occupied is considerably greater, but is there not exactly ascertained. The Littoral Amour region is also rich in forest consisting of very various and valuable species.

The vast forest resources are however distributed unequally over the extensive territory of Siberia. The greatest expanse of forest is situated in its northern part, and it is almost entirely absent in the south. According to the density of its tree covering, the whole of Siberia may be divided into three zones, of which each is distinguished by characteristic features and situated in a direction from west to east.

Northern tall tree Forests.

The zone of the northern tall-stemmed woodlands stretches uninterruptedly through all Siberia from the Ural to the eastern shores of Kamchatka. This is the zone of the Siberian urmans and taigas. To the north it borders on the tundras which is the limit of the growth of the larger vegetation. The southern side of this forest zone is determined by the line of the greatest development of corn raising and settled life. Beginning with the Turinsk district it passes through the northern part of that of Tobolsk and abruptly rises along the right bank of the Irtysh to the river Tara, embracing the northern parts of the districts of Kainsk, Tomsk and Mariinsk, thence passes through the whole of Eastern Siberia almost parallel to the main Siberian tract, and in the Transbaikal territory becomes confounded with the southern zone of the mountain forests upon the Stanovoi or Yablonovi range. These forest expanses are interrupted only by large marshes and impassable bogs wherefore many parts of this immense northern taiga have an undisputed right to be called virgin soil, as so far they have not been penetrated by the most fearless trapper. These localities, inaccessible to man, will yet long be subject to only the elemental forces of nature.

The prevailing arboreal forms in this zone are the conifers, the pine, larch, pitch pine, fir and so-called c e d a r. A complete enumeration of all the species of trees occurring in the Siberian flora with their systematic names has been made already in Chapter II, on the Geography of Siberia. In forestry it is not trees that grow solitarily but those that grow in great masses that are of importance. The deciduous trees possess in this zone an insignificant importance; the swamps show an occasional admixture of aspen and willow, and birch occurs on the skirts of the taiga. In Western Siberia, chiefly in the urmans of Tarsk, Tobolsk and Turinsk, a lime-tree is met with in the form of underwood, which supplies bark and bast which serve as a source of income to the local population.

The northern forest zone occupies all those regions of Siberia where agriculture is impossible from the deficient quantity of heat during the five months vegetative period. The fixed population in this zone is insignificant and grain raising is met with sporadically, here and there, in small patches on its southern border. The forest reaches of this vast zone have up to the present time been abandoned exclusively to the forces of nature and cannot present a pleasant spectacle to civilized man, but preserve within themselves an inexhaustible supply of splendid building material. There are many localities where for tens and hundreds of versts in every direction stand clean plantations of pine, which with their interlaced summits hide the sky. The absolutely naked trunks rising perfectly straight to an enormous height are so monotonous, that a man who once chances into such a part of the Siberian taiga, or even a wild beast, cannot find his way out again. Experienced native trappers are afraid to penetrate into these, in their opinion, enchanted spots, and they record every step they take by scoring the trees. Access to such places is difficult, and the timber contained in them is so far without value, but with the growth of the population, the improvement of the roads and the destruction of the forests in the inhabited parts, means will be found to make use of the now remote forest resources. They form indeed the wealth of the future and are merely awaiting their turn. The scourge of the forests of this zone at the present time is only the forest fires, not unfrequently devastating hundreds of versts. The burned timber is however rapidly replaced by young underwood growing up under the influence of natural selection. It must be observed however that the southern limit of the zone of high-trunked trees is gradually retreating to the north, yielding place to the raising of grain.

Birch forest zone.

The zone of birch forest covers the whole low lying or so-called steppe portion of Siberia. This area is occupied by a settled population and nearly coincides with the so-called cultivated or agricultural zone of Siberia. The principal, it may almost be said, the only forest growth of this zone is the birch with a slight admixture of aspen and t a l (salix) upon the damper spots and along the banks of the rivers. Coniferous trees are entirely absent. Merely a few plantations of these species occur on the outskirts of the birch zone, namely those of Borovliansk and Yelets-Ikovsk on the left bank of the Tobol, and Pavlodarsk and Semipalatinsk upon the right bank of the Irtysh. The two latter estates are outside the birch zone.

The birch thrives on a chernoziom soil and therefore this zone is the most populated and particularly characteristic of Western Siberia, between the middle course of the Tobol and the upper waters of the Obi. This space embraces the so-called steppes of Ishimsk, Akmolinsk, Kurudzhinsk, and Barabinsk. Although it is usual to understand by the word steppe an absolutely treeless space, in Siberia with the exception of the whole Kirghiz steppe region, which also produces over large areas shrubs used as fuel in the mining works, all the remaining plains are covered more or less thickly with birch patches or spinnies, in local language kolok s, giving the locality a very peculiar appearance. These birch copses, mingling when viewed at a distance, produce the effect of an unbroken forest. Traversing hundreds and thousands of versts by the Western Siberian tract, the traveller sees everywhere on the horizon as it were uninterrupted forests. Where here and there these birch spinnies are absent, it is in the majority of cases due to their destruction by the axe and fire and the subsequent pasturing of cattle. Thus the nomad population of the Akmolinsk territory with its numerous herds is gradually thrusting back towards the north the line of forest vegetation in the steppes, on which account the barren desert is ever advancing more and more from the south. The care of preserving these groves in the steppes should be one of the chief duties of the local authorities, especially now that a railway is being carried through this locality. The distribution of birch patches over the steppe surface may for the most part be called ideal, constituting precisely that combination of wood, arable land and pasture which is everywhere and at all times desirable in the interests of agriculture. Thanks alone to this happy disposition of the forests in this part of Siberia, notwithstanding the not wholly favourable atmospheric conditions and the mediocre soil, crops and grass thrive well. The population of this zone would not know bad harvests, were it not that the grasshopper, always laying its eggs in the treeless Kirghiz steppe, creeps thence into the rich crops of the cultivated fields. In this the most densely inhabited zone the birch furnishes the peasant with everything, timber and fuel and wood for every purpose. All the huts and farm buildings in the villages are made of it, even the roofs are of birch bark. Birch is the exclusive fuel in towns and settlements as in works, and furnishes the sole material for all farming implements. The consumption is enormous, and the birch spinnies are melting away like spring snow. This zone is now being cut through by the chief artery of the railway, which will call forth a still greater consumption of birch fuel.

The predominance of the birch in the middle low lying cultivated zone is manifested over the whole extent of Siberia from the Obi to the east. Here the birch zone continues however with some interruptions caused by the contour of the locality. It shows a more characteristic appearance in the Achinsk district and in Transbaikalia.

Mountain Woodlands.

The zone of mountain forests embraces the whole of Siberia from the south. From Semirechia to Vladivostok lies an almost uninterrupted chain of mountains, under various names, Thian-Shan, the two Alatau, Tarbagatai, Altai, Sayan, Stanovoi range, Yablonovy, and

others. The northern slopes of these mountains are almost everywhere covered with forest. Here the forest vegetation is very various, but conifers prevail, such as the larch, pitchpine, pine, cedar. They yield a timber of excellent quality, but the exploitation of mountain forest presents great difficulties. Such plantations are remote from inhabited spots, the felling of the timber upon the steep slopes is accompanied with no small risk. Not seldom the trees grow upon cones with such abrupt sides that the felled tree falls down below and is broken into shivers, damaging at the same time all the small saplings it meets with on its way. The rivers in the mountainous places are full of rapids and do not permit of raftage. In the territories of Semipalatinsk and Semirechensk the Kirghiz transport logs from the defiles upon camels. The mountain forests have an extremely great importance in the economy of the country. Independently of the fact that with the carrying through, of the railway there will appear private initiative in the exploitation of the forest wealth, the forests covering the steep sides of the mountains serve as a mighty regulator of the flushing of rivers and of the humidity of the atmosphere. Hence the proper management of the mountain forests and their defense from destruction constitute a pressing need of Siberia.

The forest areas of Siberia which have brought in, and in many places even where they do not bring in any revenue to the Crown, were for a long time free from any surveillance. Even now there is a direction in the law to the effect that «the inhabitants of Siberia are allowed the free use of the forests for all their needs and for the construction of vessels, without payment (Art. 411, Forest Code, ed. 1876). The law regarding the Siberian forests as a «gift of God», according to the expression of the peasants, or as a free gift like air and water, it was not to be expected that the local population should take any trouble to preserve them; the heaping up of windfalls, frequent fires, unsystematic felling, the pasturing of cattle upon the nearest clearings, have brought the majority of timber estates to a chaotic condition, while in the more inhabited parts of Siberia even a lack of forest has made itself felt.

From the beginning of the sixties the Government began to trouble itself about the introduction of some order into the use of the timber of Western Siberia. In 1863 in the governments of Tomsk and Tobolsk, and in the territories of Akmolinsk and Semirechensk, temporary regulations were introduced establishing a tax per stump and sagene for the use of wood. The preservation of the forests in Western Siberia was imposed by the said rules exclusively upon the rural population, allowing them in return the right of free use for their own needs, but not for sale. The looking after the fulfilment of the rules was imposed upon the volost administrations. This measure however did not bring the expected advantage. The population was burdened with a natural service, timber was cut for the works and towns, but the Crown received nothing. Nor was this all, in 1869 a law was promulgated, granting a certain company the unlimited right of making use of Siberian timber for industrial purposes. This company was permitted to cut timber free on the banks of the Obi and Yenisei and their tributaries for the building of ships and the export of lumber. (Art. 412, Forest Code, ed. 1876). Apparently this company made a generous use of the right granted it, as timber trees have almost entirely disappeared from the shores of these chief rivers of Siberia. It must however be remarked that the term of the priveleges, granted the company, has expired.

With a view to the proper administration of the forests of Western Siberia since the year 1884 it has been placed upon the same footing as that by which the Crown forests of European Russia are managed, a paid forest guard being introduced. The peasants are required to look after the forest placed at their disposal. In the course of its eight years existence, the Administration has effected not a little for the organization of the Crown forests of Western Siberia. The timber estates have been ascertained and described, every year only that part is appointed to be cut which is permissible according to the conditions of each estate; the dues have been regulated, control over the raftage of the timber has been established, as well as over the conveyance of it to the steamer wharves and the works and manufactories. By means of such measures, without any burdening of the local rural population, which as before enjoys the timber for its own domestic uses free, it has been found possible to bring the revenue of the Crown from its property in Western Siberia to 500,000 roubles a year. This figure, considerable for the present time with the existing very low prices for wood, cannot give even an approximate idea of that enormous revenue which the forest resources of Siberia promise in the near future, when the railway now being carried through the country increases the consumption of wood from the northern timber zone, and when in the south a regular sale of the same is organized to the conterminous and absolutely treeless regions of the Chinese Empire.

In Eastern Siberia all the inhabitants are allowed, as before, free use of the State forests for all their needs, and all forest control is entirely absent. To the present time only one forest estate has been declared exclusively belonging to the Crown, and this only in consequeuce of a petition of the Irkutsk Hunting Company, who took upon itself the preservation of this estate. The law, although it requires that payment for the benefit of the Crown should be exacted for all wood received from the free Government forests by the various works, and this payment be determined by the quantity of wood consumed by the works, yet as the superintendence of this is imposed upon the Crown courts and the local authorities (Art. 415 Forest Code, ed. 1876) the amount of revenue obtained is extremely insignificant. According to the returns furnished by the Irkutsk and Yeniseisk Crown Courts, the revenue received from the sale of timber and the fines for the breach of the forest code were as in the following table.

Governments:	1889.	1890.	1891.
	Roubles.		
Irkutsk.	3,550	5,812	3,543
Yeniseisk.	2,327	2,421	2,375

At the present time in consequence of the increase of the population and of the activity of the works, and also of the contemplated building of the Siberian Railway and the settlement and industrial development of the adjacent localities expected to ensue therefrom, the adoption of measures for the protection of the most important forests of Eastern Siberia is recognized

to brook no delay. The Ministry of Crown Domains is now despatching a party of forest officials to carry out the law of removing the best and most important Crown forests from the free use of the inhabitants, and of their preservation for future time by means of the formation of closed forest estates, and also for the protection of the State forests attached to various industries, works and manufactories.

In the Amour country, steps have been taken since 1888 towards ascertaining the Crown forests and the setting aside of the best of them as closed estates, but the results of the efforts of the forest officials sent into this country have not yet been made clear, the dues on the sale of timber are not yet established and the State so far receives no revenues from its vast property in this part of Siberia.

CHAPTER IX.

The Industries of the rural population.

Industrial earnings; fishing and hunting; the gathering of cedar nuts; bee keeping; the hewing of timber and wood fuel; kustar industries; the carrying trade; concluding remarks.

AFTER the sketch of agriculture, cattle raising and forestry presented in the preceding account, which constitute the chief sources of the prosperity of the mass of the Siberian population, there remains now to pass to a survey of the other and secondary sources. In consequence of their merely auxiliary importance it is only possible to set apart a much less space than was necessary to devote to agriculture, so that the pages here following will form not so much a description as a short survey, a catalogue raisonné of those industries in which the Siberian people are occupied.

Most prominent on account of the number of hands employed must be placed the fishing and hunting industries.

The internal waters of Siberia, both the large rivers and the greater part of the steppe lakes, were once very rich in fish. In the lakes there chiefly bred perch, crucian carp, pike, dace and such coarse fish; in the rivers, the most various species of white and red fish, beginning with the same perch and pike and ending with nelma, sturgeon, sterlet, eel pout, trout. The abundance of fish was fabulous. There exist credible evidence of a mass of fish, which completely filled the bed of the river from its bottom to its surface, and which even leaped into the windows of passing steamers. At the present time the supplies of fish in the Siberian waters have become considerably exhausted. In the limits of the purely agricultural zone thickly populated with Russians, fishing already almost exclusively serves the wants of the population along the banks for their own consumption, and in but few localities provides them with more important earnings. Fisheries are now principally concentrated in the lower reaches of the great Siberian rivers, outside the limits of the cultivated zone. Thus in Western Siberia there are the districts of Berezovsk, Surgutsk and Tobolsk, and the Narymsk country; in Eastern Siberia, the lower waters of the Yenisei, the Yakutsk territory, Kamchatka, et cetera. The fisheries in these parts are partly without owners, partly belong to the bank population consisting of peasants or natives. The grounds belonging to the peasants are for the most part exploited by themselves individually or on the artel principle. On the contrary, the natives work but insignificant portions of the immense fisheries which actually belong to them. The remainder they let, as a rule for a mere trifle, to the neighbouring

peasants, or, in the majority of cases, to capitalists who conduct the industry on commercial principles with the assistance of numerous parties of hired labourers.

The catching of fish is carried both summer and winter, the most various means being made use of. According to the habit of this or that fish, nets of the most various sizes, lines, seines with several scores of hooks, with bait and without, are employed. In winter, some rivers are fenced right across, and traps are placed in gaps left in the weir. At the end of the winter when the water in the rivers goes bad and the fish rushes for fresh water into the small spring streams, they are caught at such points through holes in the ice in bag-nets, ladles, and even by hand. But the wholesale fishing on commercial lines in the lower reaches of the rivers is carried on exclusively in summer, with the aid of huge drift nets 250 to 300 or more sagenes in length. In their choice of means for catching the fish, peasants and natives and the traders on a large scale trouble themselves very little about the future and do not disdain to use the most rapacious methods, to which in a large measure must be attributed the exhaustion of the supply of fish in the Siberian waters.

The fish once got, if not consumed on the spot, goes on the market either frozen or salted. But salting in Siberia is carried out very badly so that the fish acquires a bad taste and quickly spoils. This circumstance is a great obstacle to the proper development of the Siberian fishing trade.

This industry also exists in the Littoral territory in the waters of the Northern Pacific. Besides fish, seals and morses are caught. The meat and fat of the latter are eaten by the natives, the tusks alone being sold. Whales are taken in the same waters, and fur seals on the Commander Islands. This industry will be described in the next Chapter.

Hunting and trapping form the employment mainly of the population of the northern uncultivated borderland of Siberia, as also of the transition zone, separating this region from the cultivated tract. As a secondary occupation they exist also in a fair number of localities of the agricultural zone, situated near enough to the uninhabited forest areas.

The taigas and urmans form the arena of the hunter's industry, these boundless forest lands everywhere lying adjacent to the inhabited zone of Siberia on the north. This industry is conducted partly with firearms or, in the case of some natives, with bows and arrows, partly with traps of the most variable construction. The most widely spread form of sport is squirrel shooting, after which come the killing of various wood and water birds. Fur animals, formerly breeding in abundance throughout Siberia, have now, with the exception of the squirrel, common fox, ermine and bear, almost disappeared from Western Siberia, so that in that country but very few hunters are now occupied in catching either the sable or the marten. The chief supply of valuable peltry now proceeds from the northern regions of Eastern Siberia, where the destruction of wild animals has not yet assumed such dimensions. Large animals, such as bear and elk, are hunted over all Siberia, but this kind of sport is not open to every hunter but only to the more skilful and courageous. In the tundras of Eastern Siberia the native Tunguz and others hunt the northern reindeer; in the southern mountainous parts of the Eastern Siberian governments and Amouria, various kinds of animals, among others the m a r a l, or Siberian stag, whose horns fetch a high price.

The excessive hunting of valuable wild animals, and in particular, extensive forest fires in Western Siberia, compel them to emigrate, driving them mainly eastwards into the virgin thickets of the Yakutsk forests. Here the precious sable is fairly abundant, but hunters are rare. Hunting the arctic fox also forms a not inconsiderable addition to the livelihood of the Yakutsk, Dolgans and other natives. During his migration from the sea up the river, the latter is barred across with nets or fences, and this animal is sometimes caught with the aid of special traps in considerable quantities. Thus, in 1860, during a great migration of arctic foxes on the Yenisei some 7,000 of them were caught.

The earnings of the inhabitants from hunting and trapping belong to the number of the most variable. A less accidental character is attached to squirrel hunting, but even this animal, in dependence upon the harvest of fir-cones forming its chief food, sometimes retires into the most distant forests least accessible to the hunter, at others comes out upon the more nearly situated spots. In the latter case the sport yields good results. Good hunters get during a winter in the Tobolsk government 200 to 300 head, while further to the east they kill as many as 500 squirrels per gun. When the majority of the squirrels retire to the remote parts of the forest, the best hunter will not shoot even a fifth part of this figure. The hazel hen or riabchik, shot in the Tobolsk government mainly for the European Russian market, yields a fairly constant earnings, the bag in one winter reaching 50 to 100 brace, and if very successful much more. The shooting of other birds such as blackcock, wildgeese, and ducks, has not much importance in Siberia. Such birds are mostly shot for sport, and but small quantities are offered for sale. As to the pursuit of fur animals, as well as bears and other such wild animals, all here depends on chance. With luck such a chase produces earnings of hundreds of roubles. With bad luck it happens that the hunter, after wandering through the forest half the winter, returns either with nothing at all or with a booty which does not cover the cost of feeding himself and his dogs. The main fur animals taken in Eastern Siberia are the sable, fox, marten and kolonok or Siberian weasel. Ermine for the lack of demand are hardly shot at all. The chief fur traders are the natives, both because they own by prescription all the best grounds, and because they possess as regards this industry much greater knowledge, skill and endurance than the Russian peasant.

For the convenience of the natives of the northern region of the governments of Tobolsk and Yeniseisk and the territory of Yakutsk, for whom hunting forms if not the only, at any rate, one of the chief means of existence, the Government in many places makes them loans of powder, shot and lead. For this purpose the native grain stores are constantly provided with the necessary supplies of these articles, and the natives very eagerly avail themselves of the privilege in order to avoid being indebted to private traders.

The same boundless Siberian forests are the centre of another industry also very important in the economy of pretty considerable portion of the population, the gathering of cedar nuts. This industry exists in all the Siberian governments. The cedar forests, sometimes of small size, but not seldom extending to tens and hundreds of square versts, are scattered through all the urmans and taigas, and are for the most part, as mentioned above, left by the Government to the free enjoyment of all who wish to make use of them. People collect to gather these nuts from settlements situated thirty and fifty versts from the grove, and sometimes over one hundred versts.

They assemble from the more extensive regions according to the greater size of the cedar plantation itself and the better the crop. Crops do not happen every year. On an average the nut ripens once in two years, but frequently the harvests are so insignificant that cedar groves that are at all remote do not attract any traders. Good harvests generally do not occur more often than once in four or five years, and excellent harvests happen once in ten to fifteen years. In the gathering of the nut a division of labour is commonly practised. The fir cone is plucked from the cedar by the strong, skilful workmen called lazoks or climbers. They throw the fir cones on the ground where they are picked up by others, mostly youths and women. With a good harvest, a lazok and his two or three helpers will gather thirty to fifty pouds of nuts, or when the harvest is exceptional, one hundred pouds or more. In the Tobolsk government the harvests are not so great as further to the east. But as the nut sells in the government of Tobolsk much dearer, the earnings are about the same in all the Siberian governments, the relative crop being the same also. A lazok gets 50 to 100 roubles from an average harvest, and 200 to 250 roubles and more from an exceptional one. One such harvest sometimes leads to the prolonged improvement of the economical condition of that part of the population which has chanced to avail itself of it.

Among the forest industries in Siberia must also be referred bee keeping, which is fairly developed throughont the Altai mining district and in the nearest parts of the remaining districts of the Tomsk government. Bee keeping in Siberia is carried on with the help of hives of very simple construction called borts, hollowed out of thick trees. The bees are bred in the woods, and receive no artificial food, but feed themselves on the plants and bushes flourishing in the taiga. The dimensions of these bee farms are very various. Some beemasters own not more than three to five hives while others possess from five hundred to a thousand, and more. The average size of a peasant's bee garden in the localities where the industry is most highly developed, namely in the groups of settlements lying on the very edge of the taiga, may be taken as seventy-five to a hundred hives. In such places the number of beemasters forms a third, half or more of the total householders. The extent of bee keeping has now considerably diminished compared with what it was fifteen or twenty years ago. Not a few bee gardens have ceased to exist, and in those that remain the number of hives has diminished by half or more. Two causes lie at the root of this state of things, bad harvests of bee food, and diseases of the insects themselves. Numbers of hives perished altogether, while others began to yield much less honey. Formerly each hive gave not less than an average of one poud of honey, while half the quantity is now considered a very good yield.

The forest again is the arena of a whole series of industries, where nature gives man not a finished or almost finished product as in the cases above, but only a material, upon which he must expend his labour. Here first and foremost comes the hewing of timber and especially the cutting of wood fuel. The regions where these industries are most developed are scattered over all Siberia, being concentrated in the neighbourhood of the more considerable towns and along the navigable and raftable rivers. Thus Tomsk is surrounded with a region containing about fifteen thousand souls, where the preparation of wood fuel for the town population is one of the chief sources of livelihood. Similar districts encircle Tiumen, Krasnoyarsk, Irkutsk, although these towns receive the greater part of the timber and wood they require by raftage from comparatively distant localities.

As to the riverside localities, there the principal activity is connected with the furnishing the steamers with wood fuel annually consuming on the Obi alone enormous quantities. Some spots situated up stream above the more considerable towns, hew and make up into rafts both timber and fuel for the latter. Thus Tiumen gets nearly all its timber from the southern part of the Turinsk district, Tobolsk from volosts of the same district and from that of Tobolsk, lying along the river Tavda.

Every peasant hews for himself, while the large orders are undertaken by more or less extensive firms. The latter employ a mass of workmen either on hire or by special contracts.

Household industries in Siberia do not present any great variety. The most important branch, employing the greatest number of hands and affording the population the largest earnings, comprises various forms of wood industry, partly in satisfaction of the needs of the local peasantry, partly of those of the carrying trade occupying such a prominent position in Siberia. Individual kustars are met with everywhere. More or less extensive groups of kustar population are concentrated mainly in spots where there is easy access to the raw material, and a ready sale for the manufactured articles. The largest of these groups are situated around the towns of Tiumen, Tomsk and Irkutsk. The first embraces a considerable part of the Tiumensk and Turinsk districts. The articles here made are carts, shovels, wooden vessels, simple furniture, and other things used in the life of the peasantry, to which must be added wood fibre, mats, wheels, trade sledges and appliances used in fitting out caravans. Articles belonging to the first class are hawked about the villages and sold to the peasants, while those belonging to the second class find a market in Tiumen among the carriers employed in the inland trade. The needs of the latter traffic employ most of the energies of the kustars in the Tomsk region. They make sledges, carts, wheels, axles, yokes, thills, horse collars, tar, troughs for the horses, charcoal for the smithies, all of which are sold in the bazaar in Tomsk. The same goods predominate in the kustar industry of the Irkutsk region. Here, as in the Tomsk region, various kinds of wooden vessels, furniture, articles made of birch bark and some kinds of turned goods are produced, all constituting objects of every-day use among the peasantry.

It thus appears that the forest yields the Siberian peasant the most varied earnings, and is the chief source whence deficits on account of agriculture and cattle rearing are made good and the peasant's budget balanced. Unfortunately however the forest wealth of Siberia is in a lamentable state. The exhaustion of the supplies of game and fur animals was referred to above, but the forests themselves in Siberia are being destroyed exceedingly rapidly, considerably more rapidly indeed than might be expected with the actual insignificant density of the population. Of fine, actually virgin forests, at any rate in the cultivated part of Siberia, very little has remained, while the southern districts of the Western Siberian governments are already to a considerable extent stripped of trees and are experiencing a deficiency not only in timber, but not seldom also in wood fuel. The cause of this phenomenon lies in the immoderate and disorderly fellings, destroying many times more than the annual addition permits, and in the forest conflagrations extending over hundreds and thousands of square versts.

The importance of the industries not connected with the exploitation of the forests in regard to the general economy of the country is not great. Attention must here in the first place be directed to hand spinning and weaving, converting flax and wool into linen and coarse cloth. Weaving has an almost exclusively domestic character; but small quantities of linen and cloth are offered for sale, the main mass being consumed in the form of clothing by the peasantry. Further, in many localities, particularly those near the towns or the tract, home-spun linens and cloths are driven out by imported manufactured fabrics. Next, notice must be taken of the leather, sheepskin, wool beating in connection with the making of felt shoes, hat, girdle, worsted glove, and other industries, all of which are of universal occurrence. Ordinarily those employed in these industries live isolated in different settlements, occupying themselves with their particular industry as an aid to agriculture, and working in their own or the neighbouring villages at piece work upon material not their own. In some places however sheepskin dressers, makers of felt shoes, and tanners live in whole communities, specialize to a greater extent in their trade and work for the population of more considerable regions lying around. The second of these trades is established on a large scale in the Kurgan and Tiumen districts of the government of Tobolsk, which supply not only the neighbouring localities, but also the Eastern Siberian market.

Other trades are carpentry and joinery, brick making, and similar branches, which while existing everywhere, here and there form small industrial communities. Of the more refined industries may be mentioned the making of metallic sieves, carpet weaving and sign painting in the Tiumen district, the construction of mills in Ishim, the dressing of hare skins near Tomsk, the winnowing fan industry in the Mariinsk district and in the Altai, as well as some others. All these industries exist only in distinct settlements or groups of settlements, but are somewhat highly specialized in the region of their distribution and provide the population employed in them very considerable wages.

To complete the description of the peasant industries, there still remains to say a few words upon the carrier trade and the occupations connected with it. The conveyance of goods constitutes the chief form taken by this industry, and with it is occupied not only a considerable part of the population dwelling in the immediate vicinity of the tracts, but a large number of peasants living at a distance from the latter in the sphere of attraction of one or other of the leading depots, that is, mainly Tiumen, Tomsk and Irkutsk. The principal branch of this trade is that along the great Siberian tract, including the carriage of goods between the different localities of Siberia and European Russia. Next in order comes the conveyance of provisions of all kinds to the gold mines and the grounds of the native nomads, situated without the pale of the cultivated zone of Siberia; after this, follow the rest. But by far the most important of all is the traffic over the great Siberian tract of which it is necessary to speak.

The chief articles of export from European Russia into Siberia are the most varied productions of manufacturing industry, beginning with ladies fashions and confectionery and ending with machinery and bar iron. From Western Siberia into European Russia are conveyed grain and the produce from the slaughter of cattle, such as hides and tallow, while from Eastern Siberia goes almost exclusively tea with which many thous-

ands of carts are annually loaded. The total goods traffic over the Siberian tract even now employs hundreds of thousands of horses and tens of thousands of people, although as was said above its dimensions at the present time have considerably shrunk, compared with former times. At the same time the revenue therefrom has notably fallen off. While the average payment for carriage formerly for example between Tomsk and Irkutsk, about 1,500 versts, was from 2.50 to 3 roubles per poud of freight, it does not now ordinarily exceed 1.60 roubles to 1.80 roubles, and sometimes falls short of this figure. The expenses of the road on the other hand have not only not diminished, but rather, thanks to the enhancement in the price of grain, have even increased. Thus in former times a man with five horses during a trip from Tomsk to Irkutsk and back lasting two months earned, after covering all expenses, from 200 to 250 roubles. Now the net profit under average conditions does not exceed 40 to 50 roubles, and in case of misfortune, especially embezzlement of goods for which the carriers are bound to answer, not seldom large losses are incurred. The peasants continue to occupy themselves with the business of carriers under these circumstances only because, on the one hand, it is important for them to receive at one time in the form of earnest money comparatively large sums, and on the other, they count as pure profit the maintenance during the journey of man and beast whom it would otherwise be necessary to keep during the course of the winter with no return.

In any case the carrier trade on the Siberian tract is at the present day far from being what it was formerly and together with it all the earnings of the population of the points situated along the tract have fallen into decline. Among such earnings were the baiting of the caravans, the conveyance from station to station of fast traffic goods, which went by changes of horses, the replacement of tired horses in the trains of carts, the unloading and transhipping, ensuing on the freezing of rivers, or the damaging of roads, passenger traffic of the most various kinds and various occasional earnings. All this now does not yield the fourth part of the former income, and the population of the tract is forced to occupy itself ever more and more with agriculture.

The preceding disquisition has not exhausted, nay had not in view, the exhaustion of all the kinds of non-agricultural earnings falling to the peasant population of Siberia. The review of these earnings had to keep in view only the most important and to indicate their place in the economic life of the population. This place, speaking of non-agricultural earnings on the whole, is at the present time considerable only for those parts of Siberia which lie without its cultivated zone or on the borderlands of the same. In the agricultural zone non-agricultural earnings now too play a secondary part. The future of the Siberian peasantry is inseparably bound up with the future of agriculture and is therefore in close dependence on the improvement of the technical and especially of the economical surroundings of the latter.

CHAPTER X.

Hunting and the fur industry in the Far East.

The seal industry; cursory sketch thereof from the end of the eighteenth century; the Russian-American Company; Hutchinson, Cool, Filipeus and Co.; statistics of the yield of seal skins; the preparation of the fur; the trade in skins in London; activity of the firm of Hutchison and Co.; formation of the Russian Association of Seal Traders; new conditions of the lease; piratical destruction of the seals; international agreements for the regulation of the seal industry; beaver, arctic fox, morse and whale trades; fur industries; total dimensions of the yield of furs for all Siberia; mammoth ivory.

THE hunting of fur and other animals in the Far East has formed for more than a hundred years a source of revenue to the State. In consequence of the remoteness of this region, the Government always farmed out these industries to private undertakers, reserving to itself the sovereign right of controlling the regular carrying on of the industry and preserving the animals from extermination.

The most considerable of the industries named is the catching of the sea fur seal (otaria), that bear-like seal yielding an exceedingly valuable fur, while its capture is comparatively easy. The Russian name m o r s k o i k o t i k, or sea-cat, is far from answering to its appearance. The fur seal is a fairly large animal, attaining a length of seven feet, its average length being about an arshine. Extremely lively and quick in its movements in the water, on land it is exceedingly clumsy and therefore exceedingly helpless. This animal has several varieties, of which the best known is the otaria ursina or calorhinus ursinus, breeding in the northern part of the Pacific Ocean between California, Japan and Behring Straits. Another variety, otaria australis, breeds in South America on the Galopagos Islands; A third variety, otaria pusilla or arctocephalus antarcticus, breeds at the Cape of Good Hope. a fourth variety, otaria Forsteri, upon the oceanic islands near Tasmania, and others. Possessing splendid fur the otaria early attracted the attention of sea hunters, who long sought the spot where this animal comes out upon dry land to breed.

It was only at the end of the last century that the celebrated navigator, Commander Behring, succeeded in discovering a group of four islands, called in his honour the Commander Islands. One of them, upon which subsequently the navigator himself perished, was called Behring Island, and another Miedny. The two others, on account of their small dimensions,

have no importance. It was ascertained that upon Behring Island at a particular season of the year the fur seals appear in enormous numbers. However the hunters, intimately acquainted with the seal industry, were convinced that besides the said group of islands the seal must have other asylums, in the search for which much time and trouble were expended. A daring skipper, Pribylov, in a small sailing craft, the «St. George», spent two years in such quests, fortunately crowned with complete success by the discovery of a group of islands in the same Behring Sea, and called in honour of this navigator, the Pribylovs. One of these islands was named after the ship St. George; another, St. Paul. Independently of the two above-named navigators, in the part of the Pacific between the north-western shore of America and the north-eastern shore of Siberia, there constantly hovered a crowd of different adventurers, hunters of fur animals, who not seldom succeeded in discovering new lands and planting there the Russian flag. Thus, the sailor Nevodchikov, in charge of the merchant Guprov's expedition, discoverd in 1745 the Blizhni, Attu and Agatu islands. In 1759 the trader Glotov discovered the Lisi Islands. In 1760 the trader Tolstykh discovered the Andreanovsk islands, called after his Christian name, and others belonging to the Aleutian and Kuril groups.

On close examination of the matter it proved that the main mass of fur seals came out on the Pribylovs Islands. Not so very long ago there appeared upon them annually five million seals, while the number on the Commander Islands was not more than two millions. Judging however from the latest information these figures must be considerably diminished especially for the Pribylov Islands, for the animals scared by the piratical traders have of late years begun to appear more frequently upon the shore of the Kamchatka peninsula, upon the north-eastern shore of Siberia and the north-western shore of North America, and apparently the animal is becoming more marine, rarely coming out on land. Again the seals are already appearing in diminished numbers upon Tiulen Island near Sakhalin, about 10,000 only, upon the Kuril Islands forming part of Japan, at the Cape of Corinth in the Argentine Republic, at the Cape of Good Hope, upon the Falkland Islands, in Tasmania and many other places of the southern hemisphere, where it would seem the animal in question in former times was met with in countless numbers. Thus it resulted that not far back, only twenty-five years ago, Russia was the only country in whose territories the highly valuable seal industry was carried on. But since 1867, when the Russian possessions in North America, together with some islands from the Aleutian archipelago, were ceded to the Government of the United States, the advantages of this trade are shared with the latter country.

In order to explain the economical importance of the seal industry to the State and to define its dimensions, it is necessary to say something on the life of the animal itself and the value of its fur.

Of the favourite haunts of the seal in the Behring and Okhotsk seas, the Pribylov Islands, St. George and St. Paul, are now the property of the United States, and the Commander Islands, Behring and Miedny, and Tiulen are within the limits of the Russian dominions. The Commander Islands, lying at a distance apart of 30 miles, and 100 miles from the nearest point of the continent of Kamchatka, are deprived of all vegetation, covered with rocky mountains and in part with marshy tundras. The damp sea air yielding abundant

atmospheric precipitation makes the climate of these islands extremely unhealthful, and it is exceedingly probable that but for the existence there of seal rookeries they would remain uninhabited. The Tiulen Island adjoins the eastern shore of the island of Sakhalin and is as inhospitable as the Commander Islands.

At the end of April or the beginning of May the seals approach these islands; the males come out on the shore, choosing spots for the establishment of the family and defending them form being seized by others. By the end of May the females approach the shore, and are enticed upon the selected locations by the males, each male absorbing ten to fifteen females.

A male that has reached full physical development is called on the islands siekach, corrupted from the English «sea catch»; a young siekach with small withers is called a half-siekach, one without withers, a kholostiak or bachelor, and so on. The chief constituent of the catch is the kholostiak, two and three years old, which is taken at the time preceding moulting, that is to say, from the beginning of June to the middle of July, although the slaughter of the seals continues not unfrequently to September. According to Colonel Voloshinov, who was sent by the Government to investigate the position of the seal industry, the seals are killed as follows. Having found the spot upon which the flock of kholostiaks has taken up its position, the inhabitants early in the morning run out to the seashore thus cutting off the animals retreat and drive them with sticks further to the point where it is proposed to slaughter them. The seals are so helpless that ten to fifteen men can drive at once almost the same number of thousands of the animals, and then even one or two men are sufficient to hold a herd of five or six thousand seals in the drive. A group of twenty to thirty head are cut out, and when those which are suitable as to sex and age have been ascertained, they are killed by a blow on the head with a stick. The head bones of the fur seal are so weak, that with one slight blow with a stick the animal may be killed on the spot. In a few minutes on the place chosen for their slaughter a heap of slain, among which the mortally frightened animals left alive on account of their unsuitability are seen writhing, with difficulty finding their way to the sea. After finishing with one heap, a second party is divided off, and then a third, and so ou. In a short while thousands of bodies fill the place of slaughter. Twenty men can easily drive off and kill a thousand seals in the twenty-four hours. Simultaneously with the carrying on of the slaughter, another party of workmen is employed in removing the skins and salting and packing them in rows in sheds. The population of the Commander Islands occupied in killing seals consists of extremely various elements. It was formed from the workmen who were brought thither by the traders partly from the continent of Asia, partly from that of America, while others chanced here accidentally. There are thus to be met with here together with Kamchadals and Aleuts, Yakuts, Cossacks and others.

On Behring Island the conditions of life are less severe than on Miedny, and therefore the population on the former is twice that on the latter. The total population of both islands does not exceed six hundred souls. On Tiulen Island there are no fixed inhabitants, men coming there from Behring Island for the slaughter of the seals and, the work done, returning home. During nearly half the year the island is thus left unprotected and then foreign vessels

frequently call and their crews complete the slaughter of those animals still left on the island. The population of both the Commander Islands has an organization based on the commune, the whole earnings being divided among all the workmen on certain principles, a small sum being annually set apart as reserve capital. In consequence of the exceptional conditions under which the seal industry is carried on, only the ships of the lessees come near the Commander and Tiulen islands, and consequently the furnishing of the population with the necessary supplies is entirely in the hands of the Crown contractors. The latter here are afforded the right of free trade, and although by agreement the company is obliged to sell its goods at a fixed price confirmed by the authorities of the islands, this point has always called forth a number of misunderstandings. In the same way, from the absence of competition, the inhabitants of the islands were compelled to sell beaver, arctic fox, and other furs which were not included in the company's rights, at prices fixed by the agents of the latter. On concluding the agreement with the lessees of the industry, the Government held only the seal industry to be the property of the Crown, not touching the question of the beaver and arctic fox. At the same time the two latter together yielded the company enormous gains, without in any way profiting not only the State, but even the inhabitants themselves, from whom the company obtained the skins at an incredibly low price. The fishing was also free from any control on the part of the State, and beyond providing the inhabitants with food brought the latter very little advantage, although they expended no little labour upon it. Now with the new contract these conditions have been considerably changed for the better, and the relations between the aborigenes of the islands and the lessees of the industry are more clearly defined. To render clear the present position of these industries in the Far East, it is necessary to throw a hurried glance at the relation of the Government to this matter.

In the XVIIIth century, as has been already said, the fishing, fur and other industries upon the Siberian shore of the Pacific, and in the Russian possessions in North America, as well as on the Pribylov, Commander, the Kuril and other islands lying in Behring and Okhotsk seas, occupied many individual traders and companies, who possessed no regular organization. This latter fact led to constant misunderstandings among them in the settlement of which the Government was forced to interfere. To put an end to the disputes among the hunters and traders in furs and to establish a regular order for the exploitation of the business, the largest representatives of it, the merchants Shelekhov and Galikov, in 1780 formed a company with the object of despatching small expeditions «to Alaska, called the American land, to islands known and unknown, for the carrying on of the fur industry and all explorations and the establishment of free trade with the natives». The energetic initiators personally visited all the nearest islands, crossed over to the American continent and having become acquainted with the local conditions were easily convinced of the advantages of the undertaking. However to guarantee success it was necessary for them to further ensure themselves from the Government the exclusive right of carrying on the industry, which Shelekhov and Galikov succeeded, in 1788, in doing, without any particular trouble, as the Government at that time had not its own representatives in the Far East. Soon the new company was completely reorganized; new workers with fresh capital entered it, and in 1798

it was Imperially confirmed under the title of the United American Company. The Emperor Paul took a lively interest in the fate of this company; by an ukase of the 8th June, 1799, he took it under His protection and ordered it to be called the Russian-American Company, at the same time granting «in reinforcement of the undertakings of the company all possible assistance on the part of the military authorities with land and sea forces on demand made by the same». In virtue of this ukase the Russian-American Company was granted, among other things, «the right to make use of the fisheries and establishments upon the north-western shore of America, north of 55° north latitude in Behring Sea, and further on the Aleutian, Kuril and other islands; to discover and occupy lands to the south of 55° north latitude, if these lands are unoccupied by any nation; to enjoy the use of all that has yet been discovered or shall in the future be discovered in these places, both on the surface and in the bowels of the earth, without any claim on the part of others; to navigate to all the neighbouring peoples and to carry on trade with all the powers lying around»

Thus the Russian-American Company did not limit its activity to the fur trade alone, but set itself a wider scope and even had a political character. Thanks to its exclusive position, during the first term of its privilege, namely twenty years, it earned 20,024,698 roubles, paying its shareholders a dividend of 30 per cent. The continued progress of the company was still further assured when in the beginning of the twenties of the present century the Government recognized the necessity of limiting the rights of foreigners to trade in Behring Sea and the Sea of Okhotsk, as also on their shores. With varied fortune the company at the expiration of one term renewed its privilege, enjoying without competition, if not the sole, at any rate the richest fur seal fishery in the world, namely that of the Commander and Pribylov Islands, as also on the less important points of the Pacific coast of North America and Siberia within the limits of Behring Sea and the Sea of Okhotsk.

The demand for seal skins was then very small, and it was apparently declining from the beginning of the present century, as in 1817, 60,000 seals were caught on the Pribylov islands alone, while twenty years later the Russian American company took on the same islands only 7,000 skins. In the same year, 1837, about 4,000 seals were caught on the two Commander Islands, so that the total quantity of skins got by the American Company in the thirties did not exceed 11,000. These skins, dressed like any others, and even rather roughly, found a sale almost exclusively in Russia and China, in the former country, fetching about six roubles apiece. In Kiakhta these goods until March 30, 1861, were bartered for silk goods, tea, and other productions of China. In the thirties a sharp change took place in the sealskin trade. Instead of merely preparing the skin as heretofore, the fur itself was subjected to treatment, the long hair being all plucked out and the remaining down dyed a dark brown colour. An exceedingly elegant article was thus obtained and quickly a large demand for it arose in England. But in consequence of inability to salt the skins, they spoiled in the prolonged voyage in sailing vessels from the Pribylov and Commander islands to London past Cape Horn.

Notwithstanding however this inconvenience, sealskin furs began to be more highly valued in England, than in Russia and other places, so that the whole of these goods began to gravitate to London, and soon the latter became the centre of the world's

trade in sealskins. The business was so profitable that already in 1849 a special manufactory was founded in London which to this day turns out false sealskin materials. The decision taken in 1867 by the Russian Government in regard to the cession of its North American possessions with part of the Aleutian Islands, namely the Pribylovs, to the United States, put an end to the monopoly of the Russian-American Company. Deprived of its best fishery upon the Pribylov Islands it could not count on its former profits and therefore resolved to wind up its affairs, making various claims against the Government for breach of contract before its termination. In satisfaction of these the Government was obliged to buy all the company's shares, while A. Filipeus, carrying on trade in the Far East, acquired the latter's property in the ports of Kamchatka and the Sea of Okhotsk.

The Russian-American Company during the first period of its activity from 1799 to 1821, that is, 23 years, took upon the Commander, and other islands, 1,232,374 fur seal skins; during the second period from 1822 to 1841, that is, 20 years, 458,502 skins; and during the third period from 1842 to 1861, that is, 20 years, the catch was 338,600 skins.

During the last years of its existence the company considerably increased its activity, and finally in the last year, 1868, the slaughter of seals reached unheard of dimensions.

Years.	Pribylov Islands.	Commander Islands.	Years.	Pribylov Islands.	Commander Islands.
1862	34,294	4,000	1867	75,000	4,000
1863	25,000 (?)	4,500	1868	242,000	12,000
1864	26,000 (?)	5,000	1869	87,000	21,000
1865	40,000 (?)	4,000	1870	23,773	27,500
1866	42,000 (?)	4,000	—	—	—

On the termination of the activity of the company, the seal industry and trade in furs in those remote localities remained without Government control, in consequence of which the inhabitants of the Commander Islands were left without regular supplies. Interesting himself in their fate, the local Governor-General Korsakov proposed to M. Filipeus to undertake to provide the islands in question with the necessary provisions. At the same time in St. Petersburg lively negotiatious were being carried on in reference to the concession of the seal industry in the Far East to a new lessee. There was no lack of candidates, but the choice fell to the American house of «Hutchison, Cool and Co» which half a year before, on the 3rd of August, 1870, under the title of the «Alaska Trading Company» had concluded a contract with the Government of the United States of North America for the right of caching fur seals on the islands of St. George and St. Paul, forming part of the territory of Alaska. On the whole the contract with America consisted in this that the company paid the treasury 55,000 dollars a year, and in addition two dollars per skin, undertaking at the same time to engage in catching the seals only during certain named months

of the year, to the number of not more than 100,000 skins in the season on both islands The contract was concluded for 20 years till the 1st of May, 1890. For the same term the company on the 18th February, 1871, concluded a contract with the Russian Government for catching seals on the Commander Islands, Behring and Miedny, and on Tiulen Island. They bound themselves: 1. to take into their body a Russian subject; 2. to pay 5,000 roubles a year and two roubles for each fur seal skin taken from the said islands, and further to pay 50 kopecks to the inhabitants of the islands for each full-grown and perfect skin received from them. In 1877 these conditions were subjected to substantial alterations in respect to the payment per skin, so that the inhabitants were paid at the rate of one rouble instead of 50 kopecks for the first 30,000 skins, and the Crown received at the same time instead of two roubles only one rouble 75 kopecks.

The new company without delay set about placing the trade in seal skins on a more regular footing, to which contributed in particular the opening not long before, in 1869, of the Pacific Railway connecting the Atlantic with that ocean. Thanks to this new communication the Alaska Company was in a position to forward its fur goods from the Pribylov and Commander Islands to London in a shorter time. Independently of the shortening of the route, it was then recognized as advisable for the convenience of the preparation of the skin and its preservation from damage during the voyage, to salt it without previously removing the fat, which with the former method of transport oxidised and spoiled the goods. Soon the Alaska Company began to put on the London market a large quantity of skins, striving at the same time to improve the quality of their goods and to attain uniformity of selection.

The Company introduced order and system into the selection of the sort of skins and in their preparation for transport, attaining in this respect the very best results. Its goods became exemplary. During the time of its existence from 1871 to 1891 the Alaska Company got skins to the following amounts.

Years.	Commander Islands.	Pribylov Islands.	Years.	Commander Islands.	Pribylov Islands.
1871	3,412	97,002	1881	43,522	101,734
1872	29,318	101,698	1882	44,620	101,736
1873	30,396	101,555	1883	28,696	77,063
1874	31,272	107,932	1884	52,652	101,013
1875	36,274	101,249	1885	41,737	101,509
1876	26,960	89,478	1886	44,500	100,772
1877	21,532	77,956	1887	46,754	100,795
1878	31,340	101,394	1888	45,000	100,450
1879	42,752	106,908	1889	55,493	100,135
1880	48,504	100,634	1890	55,727	20,995

Judging by these data, the catch of seals on the Commander Islands is systematically increasing, while in the figures for the yield on the Pribylov Islands a certain diminution seems

to be noticeable. American investigators of the seal industry place this circumstance in dependence upon the enhanced destruction of the animal on the Pribylov Islands, in consequence of which the seals are beginning to avoid them, preferring the Commander Islands and the remotest parts of Kamchatka. But however it may be, during recent years seals have begun to appear more frequently on Russian possessions, the quality of the skins it would seem at the same time becoming better. The cause of such a change is as yet not sufficiently elucidated, but the fact itself only is established.

Although de jure the Alaska Company was the only firm possessing rich seal fisheries, yet de facto the London market was furnished with the goods in question from other sources. Skins were obtained from various parts of the Southern, Indian and Pacific oceans. In the majority of cases however the goods proved to be contraband, that is, they consisted of seal skins, taken without distinction of sex or age, on every convenient opportunity on land and sea. In consequence of such piratical character of the industry, the goods could not only not be prepared properly, but could not even be kept in good condition. They came on the London market in the majority of cases in a very bad shape, and there had to be effected the difficult task of sorting and dressing them. Of the best quality were considered the skins from the Scottish Islands, in the Antarctic Sea, next the product of the Pribylov, Commander, Tiulen, and lastly, those obtained near the shores of Victoria, upon the Kuril Islands, and near Cape Horn.

The dressing of the fur consisted of three processes, the plucking of all the long hair, the tanning of the skin and the dyeing of the short down that was left. The last operation was considered the most difficult and the secret of the process was long the property of one firm only. The whole treatment of the skin cost from 5 to 15 roubles, according to its size and quality. The selling prices were subject to great fluctuations, but on the whole, American skins were valued higher than Russian, the former fetching 30 to 45 roubles apiece, the latter only 20 to 25 roubles. According to the data of 1882, skins from the Pribylov Islands, with an average weight of 8.2 pounds, were valued at 41·62 roubles; those from Tiulen Island, weighing 9.3 pounds, 23.50 roubles; and from the Commander Islands, 9.5 pounds, 23 roubles, that is, little more than half the American. When finished, sealskins from London find a sale, mainly in America, namely about 100,000 skins per annum; next in England, 80,000; France, 15,000; Germany and other counties, 7,000; and Russia, 1,000.

Thanks to the measures referred to as taken by the Alaska Company the London fur market became more lively; in 1860, some 20,000 skins were sold there; in 1867, 52,000; in 1869, 108,000; in 1872, 129,000; in 1875, 136,000; in 1880, 148,000; in 1885, 141,000.

Almost the whole of this quantity of furs was furnished by the Pribylov and Commander Islands.

Year.	Pribylov Islands.	Commander Islands.
1875	99,634	34,479
1880	100,161	38,900

Year.	Pribylov Islands.	Commander Islands.
1885	99,874	48,929
1886	99,947	41,750
1887	99,949	54,584
1888	100,037	46,296
1889	100,031	47,411
1890	20,994	52,765
1891	17,652	59,724
1871 — 1891	1,883,897	730,539 (1873 — 1891)

Thus the success of the sealskin trade is due in a considerable degree to the Alaska Company having been able to organize on a sound basis the commercial and the industrial part of the undertaking. And yet at the same time it acted upon the islands leased by it so rapaciously, and reduced the scanty population to such a hopeless position, that it excited just reproaches both in America and in Russia. Making use of its privileged position, the Alaska Company furnished the inhabitants of the islands with all the necessary supplies, but fixed the prices so high that notwithstanding the high earnings of the inhabitants from the seal, beaver, arctic fox and fishing industries, they always remained in debt to the Company, and were constantly in want of every necessary. During the first fifteen years Messrs. Hutchinson, Cool, Filipeus and Co. paid the treasury annually 5,000 roubles, and in addition to this a payment per skin to the extent above stated, which on an average amounted to 64,420 roubles per annum, assuming the average yearly catch in Russian fisheries at 34,200 fur seals. Independently of the said payment to the Crown, the Company paid the inhabitants on an average 37,588 roubles per annum. The same Company for the same 15 years caught on the Pribylov islands on an average 95,930 seals per annum, that is, about two and a half times as many as in the Russian waters, but paid the Government of the United States much more in proportion. The lease cost 110,000 roubles, that is, 22 times that paid in Russia; the royalty payments amounted on an average to 504,000 roubles, that is, 8 times as much, and finally the inhabitants received 77,000 roubles, that is, quite twice as much, although their number on the Pribylov and Commander Islands was approximately the same. In consequence of this, in order on the one hand, to somewhat increase the revenue to the Crown from the seal industry, and on the other, as far as possible, to regulate the relations between the lessee from the Crown and the inhabitants of the Commander Islands, the question arose of the renewal of the contract with the firm of Hutchinson, Cool, Filipeus and Co. before the expiration of the lease, with the condition of the immediate increase of the payment per skin in favour of the Government.

The company expressed its readiness to increase the piece payment to 7 roubles, during the course of both a new 10 years lease and the three years unexpired of the action of the old contract. Under these conditions, the increase of the rent came out approximately at

300,000 roubles per annum. However, notwithstanding the obvious advantageousness of this proposition, nearer acquaintance with the matter showed the necessity of deferring for some time the solution of the question of retaxing the seal industry, in consequence of the question raised in 1887 of an international agreement for the adoption of measures against the piratical destruction of seals in Behring Sea. The result of this agreement determined, to a considerable degree, the profitableness of the undertaking. Moreover, it was borne in mind that the renewal of the rating of the Pribylov Islands, imminent in 1890, must affect the issue of the fixing of the rent of the Commander Islands.

The subsequent circumstances fully justified all the above stated presuppositions and at the new auction a mass of candidates appeared from among the representatives of Russian industry with more advantageons propositions. Out of many competitors the Government gave the preference to the firm «The Russian Seal Fisheries Association», founded by Grünwaldt, Lepeshkin, Prozorov and Savich, and concluded a contract with it on the following principal bases: Section 1. The term of the lease is for 10 years, till February 19, 1901; the association is to receive from the administration of the Commander Islands the skins of seals, beavers, and arctic foxes. Section 2. The quantity, season, place and method of killing the animals is determined by the local authorities. Section 4. The association pays to the Crown per sealskin 10.38 roubles; per first class beaver, 115.335 roubles; per second class beaver, 57.6675 roubles; per first class blue fox, 11.535 roubles; per second class blue fox, 5.77 roubles, and per white fox, 2.31 roubles, all in gold. Section 8. The association is bound once a year to furnish the islands with all necessaries with an addition of only 20 per cent to the purchase price. Section 11. The association must employ ships exlusively under the Russian flag. During the first year of its existence, 1891, the «Russian Seal Fisheries Association» took from the administration of the islands 30,689 sealskins, one first class and one second class beaver. In the following year, 1892, there were handed over to the same association 31,315 sealskins, to the amount of 325,049.70 roubles gold; beaver skins of the first class, 88, for 10,149.40 roubles, of the second class 108, for 6,228.9 roubles; arctic foxes of the first quanlity 1,601 for 18,467.535 roubles; of the second 807, for 4,656.39 roubles, and finally, 9 white foxes, for 20.79 roubles, or a total of 364,571.95 roubles gold, which is equivalent to half a million paper roubles.

Thus the new lessee from the Crown, notwithstanding a considerable diminution in the number of animals killed, gave the Government fully five times as much as, in the course of 20 years, was received from Hutchinson, Cool and Filipeus.

The falling off in the number of animals killed, above referred to, is explained by the activity of the piratical schooners in Russian waters, which is increasing with every year. This is caused by the increased protection of the American waters on the part of the Government of the United States. The question of the preservation of the seal industry from destruction by persons occupied in the illegal catching of these animals, possesses an extremely great international importance and therefore it is necessary to elucidate it as fully as possible. Already in the time of the Russian-American Company, which acted almost without control in Behring Sea and the Sea of Okhotsk, foreign vessels were sometimes observed to appear off Russian shores with the object of secretly bartering various goods for furs with the local inhabitants, or

even of secretly killing seals, but the said company on its part took energetic measures against such piracy, thanks to which the latter was not able to assume large dimensions. When the company's affairs were wound up, in 1868, and particularly during the time preceding the concession of the seal industry to another company in 1871, according to the evidence of the Russian Consul General in San Francisco, the regular organization of the illegal exploitation of both the seas commenced at first by the Americans and Canadians and then by all other lovers of gain at other people's expense.

In particular, Anadyr Bay with the Holy Cross and Anadyr gulfs, not being protected by Russian authorities and little visited by cruisers, became, thanks to their convenient anchorage, the favourite ground of those occupying themselves with the illegal industry. They systematically depraved the uncivilized native population, intoxicating them with brandy and receiving from them valuable furs for almost nothing. Besides this, several considerable fishing firms in San Francisco openly caught cod and other fish between Sakhalin and the Kuril chain, in the bays of Penzha, Gizhiga, Tauisk and Udsk. This they practised unpunished, due to the absence of Russian cruisers in those waters. In Kamchatka, and on the nearest islands also, a considerable quantity of fur animals were killed, such as arctic foxes, beaver, bear, red and black foxes, Siberian gray-chested foxes, sable, martens. All these valuable furs were sold by the natives to various piratical traders for brandy, powder, shot, guns and all kinds of rubbish. From this cause the sea beaver particularly suffered, their number beginning to rapidly decline from the irregular way in which they were hunted. This circumstance compelled the Russian Government to take measures against such injurious trade and with this object, in 1875 it first despatched to the Far East the clipper «Gaidamak» to suppress the illegal trade in spirits with the inhabitants of the Russian coast. Afterwards, more than once, other vessels were detached from the Pacific squadron with the same object, and since 1884 a military guard has been maintained on the Tiulen Island during the summer and autumn months. The occasional despatch of Men of War to protect the fur industries did not always attain its object, and therefore since 1891 the transport «Yakut» has been sent to cruise constantly in Behring Sea. The result was the confiscation of the piratical schooners, employed in the prohibited catching of fur seals, the crew being always set at liberty without the exaction of any fine.

The Americans on their part took a series of more energetic measures for the protection of their coast from the piratical catching of marine fur animals. For the regulation of this matter, and the establishment of a close season for seals, in 1887 arose the question of the necessity of an agreement between the governments of Russia, Great Britain, and the United States of America. The conferences however appointed to deliberate the subject, at first in London and then in Washington, with the participation of the countries interested, did not lead to any definite results; and meanwhile the piratical activity of foreigners not only continued, but apparently even increased. Fur seals were killed not only on land, but in the water without distinction of age or sex in consequence of which a quantity of animals perished without profit to anyone, as the wounded retired to sea and there died in large numbers. The destruction of the females led to the death of the young seals still dependent on

their mothers'milk. On the Tiulen Island the Russians, on returning thither in the spring, frequently found thousand of bodies of various ages, the traces left of the presence there of the pirates in the late autumn, and of their slaughter of all the animals still remaining upon the island.

The chief obstacle to the establishment of an international agreement was the declaration of the Canadian minister of navigation and fisheries, Teuner, that the multiplication of fur seals is not harmed by hunting them in the open sea but by the piratical attacks to which certain islands are subjected which possess seal rookeries, and that for the preservation of the fisheries it is perfectly sufficient to protect the rookeries. Great Britain demanded preliminarily to the decision of the question of preservation, the collection of the results of supplementary investigations upon the mode of life of the fur seal, but the Government of the United States energetically opposed the further postponement of the question of the establishment of the necessary agreement and succeeded in winning the point. In 1891 the United States of America concluded a treaty with Great Britain by which the killing of seals was temporarily prohibited for the subjects of both the said states in the waters of Behring Sea, situated to the east of a line of demarcation fixed by the treaty of 1867 between Russia and the United States. This agreement had a peculiarly fatal effect upon the Russian seal industry, as the Anglo-American pirates incommoded in the limits of the Canadian and Federal possessions, directed their criminal activity mainly to Russian waters. According to information afforded by the New-York Russian Consulate in 1891, 81 schooners were employed in the clandestine catching of seals by whom more than 50,000 skins were taken, of which about 9,500 were in Russian waters. According to the same authority, in 1892, 62 vessels were employed in this trade, two of which being steamers, and they took 45,000 skins, 15,000 of which were from Russian waters. Notwithstanding the considerable character of the figures quoted there is reason to think that they are far below the fact. The returns of the London market, which is the centre of the sealskin trade, lead to the same conclusion. According to the communication of the Governor of the Commander Islands, 60 schooners were observed in their neighbourhood in 1892, which occupied themselves with killing seals on land and on the water, one party of the pirates carrying out the slaughter while the other returned the fire of the guard protecting the fisheries. Their audacity reached such a height, that the slaughter of the seals was carried on in the rookeries themselves. This piracy is growing more and more every year and as it is the interests of Russian subjects that suffer most from it, this Government could not but direct attention to such an abnormal state of things.

The consent of Russia to the above mentioned Anglo-American agreement of 1891 would only have a value for her in case of the extension of the prohibition mentioned to the waters of Behring Sea also lying to the west of the line of demarcation of 1867. However the Government of Great Britain has declined such a statement of the question and from that time Russia has taken no further part in the negotiations. But protecting her own interests she has found it necessary to pass a new law by which the seal industry on the sea is absolutely prohibited, the killing or catching of seals, or in general, the seal industry on land, is only allowed with the permission of the Government, according to regulations established by it for the purpose. For carrying on the sea industry, as well as for the unauthorized killing on land, the guilty parties are subject to imprisonment from two

months to a year and four months, their appliances, catch and vessels used in the industry with cargo and everything on board being confiscated. To make the protection still more effective, the number of special cruisers occupied with enforcing them will soon be increased by two new vessels.

The beaver and arctic fox industries continue to remain in the same unfavourable conditions in which the seal industry was till the promulgation of the last law. Beavers appear not only on the Commander Islands but also on the coast of Kamchatka, especially near Yellow Cape where they have their dams. However the predaceous persecution to which they are subjected is forcing the animals to constantly seek new sites for their dams, more remote from man. Latterly beavers have begun to come out on the land between Capes Kamchatka and Stolbovy. The fur of the Kamchatka beaver is peculiarly highly esteemed, fetching from 300 to 400 roubles per skin, while the Commander beaver is sold at a third of that price. Thanks to the high value of the fur, beaver are hunted very energetically, in consequence of which their destruction is taking place very fast and they are becoming more and more rare.

The morse industry, like the last, is gradually declining, this circumstance being a direct consequence of the development of the piratical catching of sea mammals by English and American filibusters who shoot them with guns. The flesh of the morse is used as food, the skin for making the covering of the yurtas of the aborigenes in the Far East. The tusks form the subject of a lively trade. The filibusters further clandestinely distribute to the Chukches guns and powder for hunting the morse, and then barter the tusks for rum, brandy and tobacco.

The whale trade, as is already mentioned above, never possessed a regular organization and large commercial development in the Russian territories of Behring Sea and the Sea of Okhotsk. The whale, proceeding from the Pacific to the Arctic Ocean, collect in considerable numbers near the Chukotsk peninsula, especially between the Providence Bay and East Cape. This industry annually attracts here a crowd of American and English whalers, who partly are themselves employed in killing them,and partlyin obtaining the whalebone from the Chukches. Judging from the accounts in the American papers, specially devoted to this industry, it may be assumed that foreign whalers annually carry away from the Pacific coast of Siberia from 100,000 to 150,000 pounds of whalebone, valued at about 6 roubles a pound, not less than 100,000 pounds of morse tusks at about one rouble and fifty kopecks a pound, and a quantity of blubber and other products. Thus the whole industry in the Russian waters of the Pacific yields various products to the amount of one and a half million roubles per annum; but this trade escapes Government control being always carried on in a contraband manner.

There have been several attempts to organize the whale industry in the Far East of Russia, but not one has met with success. The credit of the last attempt of the kind belongs to the retired Captain of the second rank A. G. Dydymov, to whom the Ministry of Finance granted in 1887 a loan of 50,000 roubles for three years, for the equipment of a steam whaler, but this officer having made an excellent beginning to his enterprise in the Sea of Japan perished somewhere on the coast ot Korea at the very commencement, leaving the killing of whales in the Russian waters of the Pacific still an open question. The said industry requiring the

preliminary expenditure of a considerable capital, and presenting great danger, at the same time is ceasing to be profitable. The last circumstance is in connexion with the progress of the Russian petroleum business. With the appearance of Russian cheap kerosene in the Far East, the price of animal illuminating oil began to fall fast, and was of course unable to stand the competition of mineral oil. In consequence of this the most valuable article of the whale industry at the present time is whalebone, from which extremely solid and fine fibres are prepared which admirably replace horsehair in various plaited goods.

Independently of these two industries, there are yet others needing protection from piratical or rapacious exploitation, whether by foreigners or Russian subjects. The necessary information is being collected by the Government on the basis of which at no distant date the required rules will be drawn up.

The Okhotsk Sea, long celebrated for its abundance of fish of every kind, always attracts a crowd of fishermen who carry away out of Russian waters great quantities of fish, the most important being cod. This fish is caught most of all between Sakhalin and the Kuril Islands, and in particular between capes Olotersk and Stolbovy.

For completeness, the sketch of the fur industries in the Far East carried on in the sea and on the coast, must be supplemented by an account of the condition of analogous industries on land. Great forest fires started partly intentionally for the purpose of clearing the land for tillage, partly arising accidentally from the careless handling of fire, and most of all the rapacious destruction of timber accompanying the construction of barriers when hunting fur animals, all these causes have combined to thin the forests, which circumstance has again affected the diminution of such animals in the forests. Among the most valuable species the foremost place is taken by the sable which not so long ago occurred in vast numbers in all the forests of the Littoral Territory. Now comparatively smaller numbers are caught, namely abont 10,000 skins valued at about 100,000 roubles. Next come the ordinary, and the excessively rare black foxes, blue foxes, gluttons, ermine, raccoon, polecats, squirrels, otter, the brown and white bear, Siberian weasel et cetera.

The main mass of the peltry of the Far East on account of the insufficiency of the ordinary communications, is sold for almost nothing to Chinese factors, who export this class of goods principally to their own country. For example, in 1891 there passed through Kiakhta into China 22,590 roubles worth of otter, beaver and bear skins, 112,000 roubles worth of wolf, lynx and fox skins, and other kinds not specially named to the amount of 130,774 roubles. Thus organized the fur trade brings the country comparatively little. And yet undoubtedly this industry has a great importance especially in a country where nature has placed impassable obstacles in the way of the development of agriculture. In the greater part of the territory of the Far East, particularly in the northern zone, the nomad, nay even the settled population, is placed by climatic conditions in the regrettable necessity of contenting itself with hunting various animals, and with fishing. In many cases the Government comes to the aid of the helpless aborigenes, furnishing them with powder and shot for hunting, and in those places where fishing is the sole source of existence, Government stores are always ready, with hemp, horseh air and other articles required in the preparation of nets, and other fishing tackle. These things are distributed to the remotest re-

gions, being supplied to the well-to-do at the cost price to the Government and being issued to the poorer classes according to the resolution of the rural societies by way of loans with obligatory payment next year. Without such Government aid the population, in consequence of its extreme poverty and its not being able to acquire the tackle in sufficient quantity and of due quality, would in many places suffer frightful want of food, even although the rivers abound in fish.

As has been explained before, not only the aborigenes of the Far East but the inhabitants of many places of the original Siberia have converted the chase of wild, mainly fur animals, into an industry providing them with the necessities of life. And as nature has endowed Siberia with an enormous quantity of valuable fur animals, the said industry has a great importance to the country, the more so that, as already said, the Far East is the chief centre of the Siberian fur industries, where virgin forests, affording asylum to every wild beast, are yet preserved.

There unfortunately exist no exact statistics of the fur industry, but summing up the information in the hands of the Government and of private institutions interested in the fur trade, it may be assumed that the dimensions of the former for the whole of Siberia are approximately given in the following table:

	1879.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
Black foxes	—	2	45	34	33	30	29	24
Grey-chested	2,684	1,812	1,694	813	436	1,694	1,913	2,321
Ermine	18,454	26,313	34,254	24,536	21,618	19,011	7,306	12,416
Arctic foxes and cubs	116	294	2,495	2,891	2,927	2,866	4,099	2,986
Sable of all kinds	22,752	7,317	7,441	9,825	18,610	18,176	20,149	31,312
Otters	165	168	3,295	2,706	3,866	4,246	3,508	2,300
Red foxes	—	4,111	23,758	12,218	22,000	19,405	22,334	16,659
White (arctic) bears	3	—	10	9	3	38	28	45
Bears	314	526	1,643	1,389	1,118	432	1,114	218
Wolves and dogs	1,456	—	5,008	2,664	19,840	23,916	31,932	7,803
Mink	449	3,423	4,689	1,956	1,867	2,624	1,108	6,215
Siberian weasel	3,432	19,431	4,367	12,257	5,634	11,367	4,612	10,123
Squirrels	On an average a million skins.							
Lynx	75	—	3,597	5,206	3,109	2,489	3,485	3,395
Martens	—	4,860	6,256	1,364	9,244	4,684	2,492	6,384
Siberian tigers	6	8	4	11	21	15	9	4
» leopards	32	38	39	24	29	28	26	23
Pyzhiks	1,109	1,364	1,684	1,573	1,932	1,917	716	1,223
Cats	9,684	13,412	18,450	16,486	31,434	29,318	26,415	15,773

In explanation of the figures quoted it may be observed that herein are not included hares, as this small animal is everywhere caught, and on account of its little value, does not form an article of export, but is confined to local consumption. Moreover, herein are not included the furs taken in the lands belonging to the Cabinet of His Majesty.

From the same table it is clearly to be seen how rich Siberia is in every kind of fur, which is far from being absorbed by the local consumption. A large amount is sent through the Pacific ports of Siberia abroad, partly to America, partly to Europe, or more strictly to London. Part of the goods, offered for sale in the markets, is despatched overland through Irbit and Nizhni-Novgorod to Moscow, whence it is distributed to the whole of Russia and finds its way in considerable quantities to Leipzig. Thus the Russian fur trade is concentrated mainly not in Russia but in London and Leipzig, the more valuable furs being collected in London.

In concluding this review of the industry in fur and other wild animals in the Far East it will not be superfluous to say a few words on the gathering of mammoth ivory in supplement to what is stated above on the same subject. This business, although not organized into a regular industry, but having rather a casual character, altogether furnishes the population a pretty considerable source of income. From the Yakutsk territory alone in 1891 about 700 pouds of mammoth ivory valued at 15,000 roubles were exported. This article and morse tusks annually appear on the Yakutsk market to the amount of 30,000 to 40,000 roubles.

CHAPTER XI.

Industry, Commerce and Ways of Communication.

The mineral wealth and the mining and metallurgical industries of Siberia; general items of the mining and metallurgical industries of the Urals; the mining and metallurgical industries of Siberia; gold, silver, lead, copper, iron, tin, mercury, sulphur, coal, graphite, naphtha, salt, rare minerals and building materials.

THE Great Siberian Railway enters upon the borders of Siberia after having traversed the southern portion of the Urals, that metallurgical treasure house of Russia. The numerous iron and copper works, the gold diggings and coal fields situated along the eastern side of the Urals are, speaking strictly in a geographical sense, already within the limits of Asia, although in an administrative sense they are included in the governments of European Russia. Without touching upon the details of the mining and metallurgical industries of the Urals, it is however impossible not to mention them in an article devoted to Siberia, all the more as the construction of the Great Siberian Railway is of very great importance to the works of the Urals as a means of extending their market. During the last five years the works, mines and gold diggings of the Urals have yielded as in the following table.

	1887.	1888.	1889.	1890.	1891.
	P	o	u	d	s.
Gold	$649^3/_4$	$665^3/_4$	$641^1/_4$	$642^1/_2$	705
Platinum	269	166	161	$173^3/_4$	$258^1/_2$
Copper	163,045	156,777	157,949	173,307	174,403
Pig iron	23,425,846	24,039,236	24,725,521	27,703,679	29,923,510
Iron	13,302,405	13,360,047	14,888,720	14,716,722	15,184,924
Steel	2,328,231	2,401,104	2,583,283	2,716,238	3,464,918
Manganese ore	50,000	82,700	179,100	143,500	117,596
Coal	9,972,089	12,757,123	16,040,023	15,223,649	14,917,361
Salt	14,113,100	17,655,800	18,210,050	19,224,590	20,408,482
Sulphur pyrites	—	676,582	896,076	358,285	481,550
Chrome iron ore	—	440,868	253,732	144,667	189,047

The value of the chief products of the mining and metallurgical industries is estimated at from twenty to twenty-five million metallic roubles.

The southern portion of Siberia contains considerable deposits of every kind of mineral, and a mining industry has existed in its different regions for about two centuries. But great mineral wealth still lies untouched in the bowels of Siberia, and its exploitation will become possible when the existing economical conditions will be modified by the construction of the Great Siberian Railway.

The chief mineral riches of Siberia include, among metals, gold, silver, copper and iron. There are also deposits of mercury and tin ores. Among the carboniferous and combustible substances there are, coal and lignite, graphite, sulphur and naphtha; and among salts, common and glauber salts; besides which, Siberia is rich in all kinds of rare stones.

Gold.

At the time when the gold industry of the Urals was extending more, and penetrating to their utmost northern limits, the existence of gold was not known in Siberia and it was only in 1831 that it was found by private individuals in the mountains between the rivers Toma and Yenisei in the system of the river Kiya. And for a certain period all the endeavours of the gold workers were concentrated in this district. In 1836 they transferred their prospectings further to the east in the spurs of the Sayansk mountain chain, to the borders of the governments of Yenisei and Irkutsk. There rich deposits of gold were found in the wildest and most inaccessible places along the river Birusa. But the activity of the gold miners, whose number was constantly increasing, did not long restrict itself to the gold bearing system of the Birusa. It was enough for one daring gold miner to push towards the north, to the rivers Toungousk, to be followed by many others, and in 1840 and 1841 a large number of rich and very durable gold deposits were discovered between the Verkhnaya and Podkamennaya Toungouski, which presented a vast store of gold exceeding all those known at that time. The prospectings were pushed further and further to the east, and in 1849 the gold deposits of the Olekminsk system in the government of Yakutsk were put under exploitation. In 1854 the gold industry was established in the Bargouzinsk region of the Transbaikal province. In the Nerchinsk mining region the exploitation of gold has been carried on by the State since 1832, and private individuals were first permitted to prospect for gold in 1864, and in 1865 the exploitation of gold by private individuals was started. In the Littoral province prospecting for gold was permitted in 1866, and in 1868 it was begun in the Amour province. And lastly the discovery of gold deposits in the tributaries of the river Boureya, which fall into the Amour from the left side, was only made in 1875.

At the present time the Siberian gold industry extends over a vast area, and gold is exploited in the basins of the Obi, Yenisei, (with the Baikal) Lena and Amour, within the limits of all the governments and provinces of Siberia. The gold bearing localities along the Obi, Yenisei and Lena are situated in the basins of rivers flowing from the east that is, along the western declivity of the mountain chains which descend into the northern Siberian lowlands from the mountains which border the Arctic Ocean on the south. There are rare exceptions; the gold deposits in different parts of Siberia lie at different

altitudes above the level of the sea, but as a rule they do not rise above 2,000 feet, the height of the mountain chains being twice and three times greater. In the Kousnets Alatau the height of the mountains is from five to six thousand feet and the gold deposits become smaller and poorer as the mountain chain rises towards the south.

The geognostic character of the gold deposits of Siberia also varies in different localities. The gold bearing rock of the Kousnets Alatau is greenstone; on the eastern declinity of this mountain ridge the extreme slopes, down to the openings of the valleys, are composed of clay slate, which higher up the current changes into metamorphic and calcareous clay slates, which change into jaspers and hornblendes near their contact with the granites and diorites.

The predominating rocks of both the northern and southern parts of the Yenisei region is made up of various kinds of metamorphic slates among which clay slate predominates and in some instances passes into mica schist. The northern system also presents granites, gneisses, diorites and porphyries, which appear more rarely in the southern system. In the northern system, limestones, sandstones and conglomerites are also found in places. The gold bearing strata lie in various kinds of slates, near their contact with granites and diorites; and wherever this combination occurs gold is sure to be found. The predominating rocks in the southern regions of the government of Yenisei in the spurs of the Sayansk mountains are granite, cyanite, limestone and metamorphic slates.

In the province of Yakutsk the chief rock of the gold bearing systems of the rivers Olekma and Vitima is a granitic cyanite, which changes in places into a more laminated structure, passing into gneiss, which imperceptibly passes into micaceous, chloritic talc and clay schists. All these rocks are distinguished for their being gold bearing, especially the clay schists. The general character of the rocks of the valleys of the Nerchinsk region is the same, consisting as they do of granite, gneiss, cyanite, greenstone, diorite and dioritic cyanite and felspar porphyries. The geological structure of the gold bearing region of the Amour province, along the river Zei, is composed of micaceous and hornblend gneisses and slates. The characteristic feature of the presence of gold is the passage of the one class of rocks into the other.

The composition of the gold deposits themselves depends upon the rocks surrounding them. The thickness of the deposits varies greatly, from two feet to three sagenes and more; but generally it varies between two and seven feet. The upper strata of the deposits contain bones of mammoths, rhinoceros, and other extinct and existing animals. All the deposits are covered by a layer of earth, known as peat. The length of the deposits varies from one to fifty versts and more, sometimes with a layer of gold bearing sand, extending along their entire length of sufficient thickness for profitable working. As a rule the richness of the gold bearing strata varies in each deposit; the upper portion generally contains a small accumulation of coarse particles of gold mixed with quartz, magnetic iron and pyrites; in the middle portion the gold is finer in its particles and the sand poorer in gold, and lastly in the tail of the deposit there remains a floating gold dust which only gives traces of gold.

The soil of nearly all the northern portion of Eastern Siberia is perpetually frozen. The frozen state of the soil and the dense forests which subsequently covered the deposits have favoured the preservation of the gold in them, from the wearing and denuding action of the water. Many of the Eastern Siberian gold deposits show undoubted traces of the influence of glaciers.

Thanks to the cold climate which, following the glacial period, many of the gold deposits have been preserved to the present day in their original form, so that they present an instructive example and traces of a geological period partially contemporary with man, who has even left indubitable traces of his presence in the form of arrow heads made of jasper and quartz, hammer heads, ornaments, coins, bones et cetera.

The following table gives comparative data for the general production of gold in Russia during the last ten years together with its value, and the production in Western and Eastern Siberia.

Year.	Total production of gold in Russia.		Value in roubles (gold).	Including:					
				In Weastern Siberia.		Per cent of total production.	In Eastern Siberia.		Per cent of total production.
	Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.	
1882	2,207	10	24,277,000	126	30 1/4	5.26	1,622	31	73.52
1883	2,182	14 1/2	24,002,000	134	6	6.14	1,554	12	71.23
1884	2,178	12 3/4	23,958,000	131	7	6.01	1,561	25 1/2	71.70
1885	2,015	22 3/4	22,165,000	134	36 3/4	6.68	1,349	13	66.96
1886	2,042	4	22,462,000	136	22 3/4	6.68	1,345	1	65.86
1887	2,128	2 1/4	23,408,000	149	28	7.03	1,328	6 1/2	62.41
1888	2,146	27	23,606,000	154	6 1/4	7.17	1,326	1 3/4	61.77
1889	2,274	19 3/4	25,014,000	169	19 1/4	7.45	1,462	9 1/4	64.36
1890	2,403	25	26,433,000	160	39 3/4	6.69	1,599	1/4	66.52
1891	2,386	10 1/2	26,246,500	170	28 3/4	7.15	1,510	1 3/4	63.32

The number of men employed in the extraction of gold in Western and Eastern Siberia during the same period is shown in the following table.

Year.	Number of miners.		
	Western Siberia.	Eastern Siberia.	Total in Siberia.
1882	6,653	26,768	33,431
1883	7,148	26,252	33,400
1884	8,094	27,441	35,535
1885	8,624	27,442	36,066
1886	9,158	25,593	34,751
1887	11,616	23,203	34,819
1888	11,460	24,803	36,263
1889	10,585	26,697	37,282
1890	9,512	28,242	37,754
1891	9,454	27,521	36,975

On comparing these two tables it is seen that although Eastern Siberia employs only three times as many men as Western Siberia yet its production is nine or ten times as great. This is due to the greater richness of the deposits worked in the former region. Owing to the dearness of provisions and forage, and consequently of labour and horses in Eastern Siberia, the exploitation of the poorer deposits is impossible with the methods now in use for treating the gold bearing sand.

When in 1829 the Siberian gold industry was made free to private individuals a great number of enterprising men and large capital found their way to this remote region. The gold miners became rich themselves and aided the development of the region with a generous hand, laying down roads to inaccessible places, establishing a steam navigation along the abundant Siberian rivers, and sacrificing considerable sums to the erection of national institutions, such as schools, churches and every kind of charitable and pious work. The development of the gold industry reflected itself upon the towns of Tomsk, Krasnoyarsk, Irkutsk, Chita, Nerchinsk and Blagoveschensk.

Beyond the 40,000 miners employed at the mines themselves, the Siberian gold industry gives occupation to a considerable population in the transport of goods to the mines and other auxiliary works. Indeed it indirectly aids the development of agriculture in the neighbouring agricultural districts and it presents a profitable market for their produce.

The extent of the sums acquired by the country from the gold industry is seen from the following example. During the three years 1887 to 1889, the wages of the men employed in the gold mines of the Olekminsk and Vitimsk systems amounted to 6,789,000 roubles, while the cost of the chief objects of consumption at those mines was 12,268,000 roubles. These figures give an excellent idea of how vast an amount of money the gold industry distributes over the entire region and how it supports its population, trade and industry.

Passing from these general data respecting the Siberian gold industry, its individual features according to the systems of the chief Siberian rivers may be considered.

In the vast basin of the Obi the gold industry has been established: 1. On the steppe land extremity of Siberia in the provinces of Akmolinsk and Semipalatinsk, along the rivers belonging to the system of the left branch of the Obi-Irtysh system of the river Irtysh; 2. On the western side of the Kouznets Alatau in the Mariinsk region of the government of Tomsk. 3. In the Altai mining region; 4. On the eastern side of the Kouznets Alataou in the Achinsk region of the government of Yenisei.

Owing to the difference of the natural conditions in the different gold bearing regions, the modes and processes of extraction also differ. In the steppe region the mining is exclusively open workings, so that deposits with deep lying strata are not worked owing to the great expense of the timber required for supporting underground minings. Thanks to the warm climate the washing of the sand is carried on from April to October, that is, during about seven months. The workings are surrounded by a nomad Kirghiz and Cossacks population, who work in the mines partly for so much per cubic sagene of earth, and partly at so much per zolotnik of gold extracted, and besides this, they serve as the providers of provisions to the mines. Hence the gold industry in the steppe region is not hampered by great preliminary expenses. Moreover, the wages and living of the miners is far less in the steppe than

in the forest region, and therefore it is possible to exploit comparatively very poor deposits, in which the amount of gold does not in some cases exceed 8 doleys per hundred pouds, of sand, or 0.00002 per cent.

In the forest region which embraces the Altai mining region, the Mariinsk region of the government of Tomsk, and the Achinsk region of the government of Yenisei, the climate is more severe and the washing of the gold can only be carried on during five or at most six months. The population is more sparse and the conditions of the industry begin to acquire another aspect, more like that which predominated, in general, in Eastern Siberia.

In the Achinsk region the gold industry is concentrated at the sources of the Chulyma along the rivers Belaya, Chernaya and Sarala-Use.

In the Altai mining region the gold mines are exploited both by His Imperial Majesty's Cabinet and by private individuals.

The following table gives the number of gold mines worked and their yield during the last ten years both in the different provinces and in the varions regions of the Obi system.

Year	Akmolinsk province.			Semipalatinsk province.			Government of Tomsk.									Gov. of Yenisei.		
							Mariinsk region.			Altai mining region.						Achinsk region.		
										Alluvial gold.			Quartz gold.					
	Number of deposits.	Yield of gold.		Number of deposits.	Yield of gold.		Number of deposits.	Yield of gold.		Number of deposits.	Yield of gold.		Number of deposits.	Yield of gold.		Number of deposits.	Yield of gold.	
		Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.
1882	10	2	24	29	11	7¾	71	34	8¼	47	74	6¾	2	4	23¾	31	22	2¼
1883	12	5	31	31	8	29¼	70	38	23½	50	79	—	2	3	9½	33	17	16¾
1884	20	7	37¼	27	7	2¾	86	33	¾	54	77	11	2	4	28¼	40	18	34¼
1885	29	7	39¼	27	6	16¼	95	32	30¼	59	82	39½	2	4	31	37	19	15½
1886	28	6	17	26	7	34¾	104	36	29¼	56	79	14½	2	6	8½	36	17	21¾
1887	30	6	19¾	32	12	4¾	116	36	21¼	69	87	36½	2	6	27	42	18	9
1888	29	7	14	35	14	25¼	112	37	19¾	75	88	1	2	6	26¼	37	20	29¾
1889	32	4	28½	38	14	33½	118	40	25½	75	102	49½	2	6	2½	36	23	13¾
1890	25	2	19¾	37	13	32½	105	33	25	77	105	6	2	5	34	35	21	24
1891	25	2	37¾	43	16	25½	103	31	35	77	113	10¼	2	5	31	33	25	38

Thus the gold industry is very feebly developed in the Akmolinsk and Semipalatinsk provinces. In the Mariinsk region the production of gold is subject to very slight fluctuations, notwithstanding the increased number of deposits under exploitation and the larger amount of gold bearing sand treated in them. This shows that the richer deposits have been exhausted and that the exploitation of the poorer can be carried on profitably owing to the

low price of labour and provisions at the gold mines of this region. The amount of gold obtained in the Altai region is constantly increasing owing to the gold bearing sands being of very uniform richness while the number of deposits worked is on the increase. This also proves that the stores of gold in the deposits of the Altai region are not yet exhausted. Gold quartz is worked at two mines in the Altai but the amount produced is still inconsiderable. During the last ten years the production of the Achinsk region has varied very slightly. Of all the gold deposits in the Obi system, those in the Mariinsk, Altai and Achinsk regions are the most profitable for exploitation, owing to their proximity to the railway; and there is reason for thinking that the extraction of gold will be further developed in these districts.

The following table gives the number of men employed at the gold mines during the last ten years.

Year.	Akmolinsk province.	Semipalatinsk province.	Gov. of Tomsk.		Gov. of Yenisei.
			Mariinsk region.	Altai region.	Achinsk region.
1882	431	1,785	1,877	2,560	1,028
1883	884	1,637	2,053	2,577	922
1884	1,537	1,601	2,093	2,863	825
1885	1,897	1,565	2,068	3,094	857
1886	2,135	1,544	2,203	3,274	876
1887	3,210	1,928	2,490	3,988	1,055
1888	2,899	2,408	2,185	3,968	916
1889	2,228	2,114	2,137	4,070	935
1890	1,536	2,045	1,890	3,931	1,061
1891	400	2,688	1,858	4,407	952

The great river province of the Yenisei comprises four gold bearing regions, the Minousinsk, Krasnoyarsk, Yeniseisk (which subdivides itself into two parts or systems, the northern and southern), and Nizhneoudinsk.

The Minousinsk region, where gold was first prospected for in 1832, enjoys a comparatively moderate climate, an abundance of pasture and corn, and yet the gold industry of this region developes very slowly. This is chiefly owing to the distance, 300 to 350 versts, of the deposits from the centres of population. The amount of gold produced in the Minousinsk district remains nearly stationary.

In the Krasnoyarsk region, where the exploitation of gold was started in 1847, only three deposits are worked at the present day. The amount of gold washed in 1884 was nearly six pouds, while in the remaining years it varied between one and four pouds.

In the Yeniseisk region the most important gold producing localities are the valleys of the rivers Sevaglikone, Ogne, Kalami and Enashimo, belonging to the system of the Podkamennaya Toungouska, and also of the Aktolika and Bangash belonging to the basin of the

Pita, all in the northern system; the basin of the river Ouderei which falls into the tributary of the Angara, the Kamenka and the basins of the rivers Bolshaya Mourozhnaya and Pita, all in the southern system. In the majority of instances the rivers of both systems have a rapid current owing to the sharpness of their fall. During the heavy spring rains, they rapidly become swollen and overflow their courses, and although, owing to the steapness of their beds, they do not overflow to any great extent, nevertheless they frequently cause great damage to the gold workings. On the other hand during the prolonged summer droughts some of them become so shallow that it is necessary to stop washing the sands.

The rivers in the Yenisei region are not navigable, with the exception of the lower portions of the Yenisei, Podkamenaya Toungouska and Bolshaia Pita. The more considerable tributaries of these rivers are only navigable to small boats and rafts.

The gold extracted in the Yeniseisk region is generally finely granular, tabular and, as it were, rubbed; a coarsely grained gold of high purity is found along the rivers Ogne and Enashimo.

In the northern system the thickness of the gold bearing deposits varies from two to eight feet, although there are some which are as much as 15, 20 and even 35 feet thick. In the southern system the thickness of the deposits generally varies between two and twelve feet. The superficial covering of peat is in both cases between 5 and 30 feet. The average richness of the gold bearing sand in the northern system is about 31 dolias of gold per hundred pouds, but in the southern system it is somewhat less. However, in both systems there are workings in which the quantity of gold reaches one zolotnik per poud.

In the Yeniseisk region the first deposits were discovered in the present southern system, along the rivers Ouderei and Mamona, in the year 1838. At that time the workings of the Birusinsk system, in the Nizhneoudinsk region of the government of Irkutsk were of great importance, owing to the abundance of gold they yeilded. As however the newly discovered deposits in the Yeniseisk region were found to excel those of the Berusinsk system in richness, numerous prospecting expeditions were dispatched to this region, and in 1839 the deposits of the northern system were discovered in the valleys of the rivers Aktolik and Vangash, while in the beginning of the forties all the present gold districts were covered with claims, although their exploration is being carried on to the present day. In the Yeniseisk region, as everywhere, the richest deposits were discovered first, and therefore the yield of gold from this region attained its maximum soon after its discovery, and then began to gradually decline. By the amount of gold produced, the Yeniseisk doposits stand among the richest in Russia. In the first year after the gold washing was begun, and when only one mine was under exploitation, with 190 miners, the yield exceeded $7^1/_2$ pouds of gold. Subsequently the number of mines, and the yield of gold increased year by year; the maximum yield coincides with the year 1847 when 1,212 pounds $12^1/_2$ pounds of gold were produced by 12,100 miners. This amount formed about 65 per cent of the production in Russia during that year. After 1847 the amount of gold extracted began to lessen, notwithstanding the increased number of miners, which in 1854 amounted to 20,567, and also the increased number of mines and the quantity of sand washed therein. The exploitation of the gold no longer formed an attraction for large companies and gradually began to fall into the hands of small enterprises.

In 1882 the exploitation of veinous gold was started in the Yeniseisk region, but it developes very slowly, and as yet the production has never exceeded eight pouds, and in recent years has even been under one and one-half pouds.

The gold workings of the Nizhneoudinsk region of the government of Irkutsk and of the Kansk region of the government of Yeniseisk, are situated along the system of the river Birusa. Only the upper courses of this river pass through the Nizhneoudinsk region, after which it flows through the Kansk region of the government of Yeniseisk. At the present time these region occupy almost the last place among the Siberian gold producing regions, although formerly the Berusinsk system was among the richest in Eastern Siberia.

The first discovery of gold in the Birusinsk system was made in 1836. The richness of the deposits of this system attracted numerous prospecting parties, and already in 1839 the Kansk and Nizhneoudinsk regions yielded about $41\frac{1}{2}$ pouds of gold, out of a total of $48\frac{1}{2}$ pouds extracted in Eastern Siberia. The maximum yield of gold from these regions was in 1842 when it equaled 204 pouds 6 pounds, or about 20 per cent of the total production in Russia. Since then the production of gold in these regions has gradually decreased, and in some years has even fallen below 15 pouds. However this decrease should not be ascribed to the exhaustion of the mines but chiefly to the discoveries of gold in other systems, and there is reason for thinking that if more detailed explorations were made, and the exploitation of the deposits more scientifically carried out, then the Berusinsk system would once more stand to the fore.

The following table gives the production of the gold-bearing regions of the Yeniseisk system during the period 1882 to 1891.

Year.	Minousinsk region.			Krasnoyarsk region.			Yeniseisk region. Northern system.			Yeniseisk region. Southern system.			Kansk and Nizhneoudinsk regions.		
	Number of workings.	Production of gold.		Number of workings.	Production of gold.		Number of workings.	Production of gold.		Number of workings.	Production of gold.		Number of workings.	Production of gold.	
		Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.
1882	41	30	$37\frac{1}{2}$	1	2	$\frac{1}{2}$	86	95	$36\frac{3}{4}$	134	115	$18\frac{1}{2}$	26	17	$31\frac{3}{4}$
1883	41	30	$3\frac{1}{4}$	3	3	32	95	93	$13\frac{1}{2}$	135	125	30	29	22	$14\frac{1}{4}$
1884	42	34	$39\frac{1}{2}$	3	5	$38\frac{3}{4}$	89	106	$36\frac{1}{2}$	130	126	$7\frac{1}{4}$	33	29	$9\frac{1}{4}$
1885	40	32	$13\frac{3}{4}$	2	4	$11\frac{1}{4}$	105	106	$21\frac{3}{4}$	149	118	$32\frac{1}{2}$	27	27	$23\frac{1}{4}$
1886	41	31	$10\frac{1}{4}$	2	4	$6\frac{3}{4}$	91	97	$39\frac{1}{4}$	151	115	26	34	22	$4\frac{3}{4}$
1887	41	30	$24\frac{3}{4}$	4	2	$34\frac{3}{4}$	110	100	$16\frac{1}{4}$	153	125	$27\frac{1}{4}$	31	21	$27\frac{3}{4}$
1888	43	32	2	3	1	29	109	97	$19\frac{1}{2}$	145	123	$22\frac{1}{4}$	27	23	$22\frac{1}{4}$
1889	46	26	$24\frac{1}{2}$	3	2	$2\frac{1}{2}$	104	83	34	148	105	$35\frac{1}{2}$	32	28	$7\frac{1}{4}$
1890	45	28	$8\frac{1}{4}$	3	1	14	113	88	36	143	123	$2\frac{1}{2}$	33	24	$33\frac{1}{2}$
1891	24	34	$16\frac{1}{4}$	3	1	$8\frac{1}{4}$	106	78	5	139	117	$3\frac{1}{2}$	31	24	$18\frac{3}{4}$

The number of men employed in the gold mines of the same regions is shown in the below table.

Year.	Minousinsk region.	Krasnoyarsk region.	Yeniseisk region. Northern system.	Yeniseisk region. Southern system.	Kansk and Nizhneoudinsk regions.
1882	1,122	60	4,278	4,297	368
1883	1,102	182	4,447	4,618	591
1884	917	163	4,698	3,626	1.599
1885	1,128	123	4,533	4,989	1,078
1886	1,167	138	3,807	5,477	601
1887	1,343	124	3.624	4,750	543
1888	1,379	51	3,732	4,436	762
1889	1,187	95	3,883	4,440	1,332
1890	1,242	85	4,183	4,476	1,076
1891	1,441	71	3,376	4,408	1,089

The Verkhneoudinsk region of the Transbaikal province is situated along the rivers flowing into Lake Baikal, and from it through the Angara into the Yenisei. The gold deposits of this region are situated in its south-eastern portion, near the Chinese frontier, along the tributaries of the river Chika, which falls into the river Selenga. These deposits lie in narrow valleys, surrounded by high mountains covered with forests. Although the number of deposits under exploitation is gradually increasing, still the yield of gold remains very limited.

The following data refer to the Verkhneoudinsk region.

Year.	Number of workings.	Production of gold.		Number of mines.	Year.	Number of workings.	Production of gold.		Number of miners.
		Pouds.	Pounds.				Pouds.	Pounds.	
1882	12	3	14½	285	1887	12	—	32¾	186
1883	6	3	6½	200	1888	15	1	20	179
1884	9	1	36½	245	1889	12	3	21¾	192
1885	9	2	31¼	235	1890	17	2	35½	319
1886	11	—	27	211	1891	15	4	36¾	173

The gold workings belonging to the system of the river Lena are situated in the regions of Verkholensk and Kirensk in the government of Irkutsk, in the region of Bargouzinsk in the Transbaikal province and in the region of Olekminsk in the province of Yakutsk. Although the upper courses of the Lena abound in gold deposits, they are generally poor, and therefore the number of deposits under exploitation and the amount of gold produced in the Verkholensk and Kirensk regions is inconsiderable. The gold workings of the Bargouzinsk region are situated to the east of Lake Baikal along the upper courses of the river Vitima

which flows into Lena from the right side. Although during the last ten years the number of deposits under exploitation has more than doubled, yet the number of men employed has scarcely varied, and the amount of gold produced has, if anything, decreased.

Of all the above cited regions appertaining to the system of the Lena, the most important in respect to the yield of gold and number of men employed, is the Olekminsk region, situated in the south-western portion of the Yakutsk province. All the gold deposits of this region are included between 53 and 60° north latitude and between 130 and 138° east longitute from Paris, and are bounded: to east by the river Olekma, to the north and north-west by the river Lena, to the west and south-west by the river Vitima, and finally to the south by the Yablonovoy mountain chain, which is here the watershed of the tributaries of the Lena and Amour. This region is intersected in all directions by the spurs of the Mouisk and Yablonovoy mountains, and has quite an Alpine character. One of the chief spurs of the Mouisk mountains extends parallel to the river Vitima and this divides the Olekminsk region into two systems, the Vitimsk and the Olekminsk. The Vitimsk system lies to the north-east of Irkutsk at a distance of 1,700 versts from it. The Olekminsk system extends in the same direction still further across the watershed of the Lena and Vitima, so that in reality this watershed forms the true boundary between the two systems. Both systems are at an equal altitude above the level of the sea, nor is there any geological difference between them, as the same rocks predominate in both. The gold deposits, known up to the present time, almost blend into one another and the distance across the intermediate mountain chain does not exceed fifteen versts.

Among the rivers along which the gold deposits of the Vitimsk system are situated, the river Bodaibo deserves particular attention, as all its system is exceedingly rich in gold, and the richest deposits are situated over a comparatively small area in this system. There are also rich deposits near the upper courses of the gold bearing tributaries of the Vitima, beyond the watershed along the tributaries of the rivers flowing into the Lena. Among the tributaries of the Lena which water the Olekminsk system, the most noteworthy are the systems of the Great and Little Patomo; and of the tributaries of the Olekma, the most notable are the rivulets of Zhuya, Bogolonak, Khomolkho and Vacha.

The gold obtained from the Olekminsk-Vitimsk deposits is distinguished for the size of its grains, so that nuggets of $^1/_4$ pound and more in weight are frequently found. Besides this, the gold from these deposits is distinguished for its somewhat regular crystalline form. With respect to the mode of occurrence of the gold bearing strata, it should be mentioned that the gold of the Olekminsk-Vitimsk deposits has the peculiarity of being distributed in alluvial deposits in two, and not unfrequently even in three layers. The average richness of the gold bearing sands during recent years has been: in the Olekminsk system from $1^1/_2$ to $1^3/_4$ zolotniks, and in the Vitimsk system from 3 to $4^3/_4$ zolotniks per 100 pouds of sand. However, in some workings the amount of gold is as much as $5^1/_2$ zolotniks and more per 100 pouds of sand. The thickness of the gold veins is from 2 to 15 feet and the thickness of the superincumbent dirt or peat varies between half a sagene to 20 sagenes. The largest workings are chiefly concentrated in the deposits situated at a greater depth below the surface; as in the Olekminsk and Vitimsk systems these deposits are the richest.

The greater part of the peat and gold bearing sand is in a perpetually frozen state, but sometimes the gold bearing rock stuff is unfrozen, and lastly a combination of the one and the other is sometimes met with, but this phenomena has not been sufficiently investigated for it to serve as a guide in the exploitation of the deposits in which it occurs. There are frequent instances where the frozen state of the soil is taken advantage of for sinking shafts in those deposits which lie at some depth and which are exploited by underground workings.

The gold workings of the Vitimsk and Olekminsk systems have their stations or chief depots on the banks of the Lena near the mouths of the river Vitima. The workings of the Olekminsk system are situated at a distance of about 350 versts from the depots, and vehicular communication can only be carried on in the winter over the ice; and in summer the goods have to be transported on the backs of camels. For working, the Vitimsk system is much more advantageously situated, as in summer there is a steamer communication from the mouth of the Vitima to a distance of 300 versts up the river Bodaibo, where the gold workings of this system begin; moreover the mines are connected by a carriage road. The miners of the Olekminsk diggings are chiefly hired from Irkutsk, whence also all the provisions and articles necessary for the workings and miners are bought.

Notwithstanding the comparative infancy of the gold industry in those regions, and the difficulties which are encountered in the severity of the climate, dearness of labour and the distance from any inhabited place, still the production of gold has developed rapidly, and in the Olekminsk region, reached a maximum of 939 pouds in 1880; indeed since 1868 this region has stood first among all the gold regions of Siberia in respect to its yield of precious metal.

The following table gives the production of the gold regions belonging to the Lena system, during the last ten years.

Year.	Verkholensk and Kirensk regions.			Bargouzinsk regions.			Olekminsk region.		
	Number of workings.	Production of gold.		Number of workings.	Production of gold.		Number of workings.	Production of gold.	
		Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.
1882	1	—	4	25	34	$1\frac{1}{2}$	62	759	$1\frac{1}{2}$
1883	1	—	$4\frac{1}{4}$	24	29	$18\frac{3}{4}$	58	686	$5\frac{1}{2}$
1884	2	—	4	24	24	$38\frac{1}{4}$	57	704	13
1885	2	—	$14\frac{1}{2}$	24	24	$15\frac{3}{4}$	65	538	39
1886	2	1	18	37	25	10	64	466	$32\frac{3}{4}$
1887	2	—	$22\frac{1}{2}$	29	34	$11\frac{1}{2}$	75	451	$7\frac{1}{2}$
1888	4	3	$14\frac{1}{4}$	41	25	$9\frac{1}{4}$	78	464	$3\frac{3}{4}$
1889	5	7	36	55	34	$26\frac{1}{4}$	77	495	$29\frac{1}{4}$
1890	4	4	19	60	31	$8\frac{3}{4}$	79	575	$33\frac{1}{2}$
1891	4	7	34	64	27	35	87	545	$27\frac{1}{2}$

The following table gives the number of miners employed in these regions during the same period.

Years.	Verkholensk and Kirensk region.	Bargouzinsk region.	Olekminsk region.	Years.	Verkholensk and Kirensk region.	Bargouzinsk region.	Olekminsk region.
1882	10	940	4,558	1887	20	862	5,073
1883	6	839	3,529	1888	21	1,225	5,638
1884	20	482	5,421	1889	199	1,036	5,880
1885	11	789	5,278	1890	120	995	6,464
1886	53	643	4,910	1891	119	738	6,772

In 1889 the workings of both systems of the Olekminsk region employed 2,340 horses and 2,100 reindeer. The native Tunguz and Yakuts transport the building timber and pit props reguired at the mines, by reindeer. Passing now to a review of the gold deposits in the vast river province of the Amour, it should be mentioned that the Nerchinsk mining region is in the uppermost courses of this system, along the tributaries of the Shilka and Argouna. The gold deposits of the Nerchinsk region are subdivided into four administrative regions: the Chitinsk, Akshinsk, Nerchinsk and the Nerchinsk metallurgical regions, situated between 128 and 137° east longitude and 49 and 53° north latitude. Veinous gold was discovered in the Nerchinsk region so far back as 1777, but owing to the poorness of the ore it was not worked. In 1838 promising alluvial deposits were discovered in the valley of the river Kara, the left hand tributary of the Shilka. These workings which are exploited to the present day, long remained the only ones of any consideration in the district. In 1853 the Shakhtalinsk deposit was opened out, and in 1865 the deposits along the rivulet Chernaya Ougruma were discovered; the latter remain the richest to the present time. Since 1865 when the Nerchinsk region was opened to private enterprise, the production of gold has grudually increased. At present, gold is extracted in the eastern portion of the Transbaikal province, in the Akshinsk region along the systems of the rivers Onon, Ingoda and Nercha, and in the Nerchinsk region along the systems of the rivers Ougruma, Gazimoura, Ounda, Nercha and Shilka. Veinous gold is also worked in the Chitinsk and Akshinsk regions. The alluvial deposits of the Amour and Littoral provinces are situated in the basins of the left tributaries of the Amour, within an area lying approximately between 52 and 56° north latitude and 120 to 138° east longitude from Paris.

From their geographical position the gold deposits of the Amour may be divided into several groups, lying in the following order from west to east. The gold bearing district of the first group is situated on the watershed between the Amour and Zea, in the neighbourhood of Albazine at a distance of 100 versts from the Amour. The deposits of this group were the first discovered in the Amour province, in 1866, by the well known mining engineer Anosov, who during 12 years endured every privation in an untiring exploration

of the mineral wealth of the region of the Amour. At that time this region was entirely unknown to industry, and was at a distance of 500 versts from the inhabited localities of the Transbaikal province. During the first year, 1868, following the institution of gold workings in this district, 50 pouds of gold were extracted and the average richness of the deposits was found to be over three zolotniks per hundred pouds of sand. The second group of deposits in the gold bearing region, is comprised by the tributaries of the rivers Gilui and Brianta which fall into the river Zea from the right side. This group comprises some of the richest deposits now known, and was also discovered by Anosov. The exploitation of the gold deposits in this district, where over the whole area between the rivers Gilui and Brianta there is no stream which is not in some degree gold bearing, was begun in 1876, and in 1883 a vein deposit was also discovered.

The third group of deposits is situated along the system of the river Selendzha, the left tributary of the river Zea. In 1874 a whole series of deposits was discovered here after the indication of Anosov. The fourth group, comprising the system of the upper courses of the river Niman, the right tributary of the river Boureya, was also discovered after the indication of Anosov, in 1875. A series of deposits was disclosed here at a distance of six hundred versts from the junction of the Boureya and Amour. These deposits proved to be exceedingly rich in gold, and the fame of their discovery soon penetrated into industrial spheres and attracted numerous prospecting parties to this perfectly desert region. The same mountain chain that gives rise to the Selendzha and Niman, also forms the source, only on its eastern side in the Littoral province, of the river Amgoun which falls into the Amour from the left at about 90 versts distance from its mouth. In 1868, the fifth and most eastern group of the deposits of the Amour gold bearing region, was discovered in the system of the river Amgoun. The gold bearing beds in the Amour deposits are under very favourable conditions for exploitation. They lie at an inconsiderable depth; the average thickness of the peat is about one sagene and the thickness of the gold bearing bed, half a sagene. Hence all the deposits are exploited by open workings, and only in certain of those along the river Niman, where the thickness of the peat exceed 20 feet and of the gold bearing bed 9 feet, are underground minings carried on. Besides the actual localities belonging to the system of the Amour within the borders of the Littoral province in its southern portion, numerous gold deposits have been found in many parts of the continent and also on the island of Askolda, near Vladivostok, where the gold bearing seam forms the bottom of the sea and whence a gold bearing sand is extracted.

The gold workings of all the above cited groups of the Amour system, have their depot stations on the Amour, Zea, Boureya and Amgoun. There is a steamboat communication on the three last named rivers, for a distance up to 400 versts from their mouths. The remaining distance of 200 to 400 versts is partly traversed in boats and partly on horseback along paths leading through the midst of the taiga to the gold workings. In winter only is there the possibility of a more convenient communication between the mines and their depot stations, whence they obtain all their provisions in the winter. Owing to this circumstance the cost of labour along the system of the Zea amounts from 1,000 to 1,200 roubles per head, and on the Niman it even comes to 1,500 and 1,900 roubles. Notwith-

standing these very disadvantageous economic conditions the gold workings of the Amour province are gradually enlarging their production, and moreover the number of deposits under exploitation is constantly increasing. The following table gives the production and number of workings in the Amour river system; all the workings in the Transbaikal province belonging to this system, being grouped under the general designation of the deposits of the Nerchinsk region.

Year.	Nerchinsk region.			Amour province.			Littoral province.		
	Number of workings.	Production of gold.		Number of workings.	Production of gold.		Number of workings.	Production of gold.	
		Pouds.	Pounds.		Pouds.	Pounds.		Pouds.	Pounds.
1882	48	271	$22\frac{3}{4}$	15	254	$16\frac{1}{4}$	3	16	$2\frac{3}{4}$
1883	53	271	$16\frac{3}{4}$	19	248	$38\frac{3}{4}$	3	22	20
1884	52	259	$30\frac{3}{4}$	22	323	$24\frac{1}{2}$	2	20	$32\frac{3}{4}$
1885	51	149	$24\frac{1}{4}$	22	302	$13\frac{1}{2}$	4	21	$37\frac{1}{4}$
1886	51	204	$28\frac{1}{2}$	19	345	$15\frac{3}{4}$	2	11	$29\frac{1}{2}$
1887	57	179	$15\frac{3}{4}$	21	355	$22\frac{3}{4}$	3	6	$33\frac{1}{2}$
1888	57	146	$12\frac{1}{4}$	22	377	$18\frac{1}{4}$	4	8	$38\frac{1}{4}$
1889	74	183	$25\frac{3}{4}$	34	458	$18\frac{3}{4}$	3	7	14
1890	79	204	1	51	485	$25\frac{1}{2}$	3	6	$38\frac{1}{4}$
1891	83	198	$\frac{1}{2}$	47	427	$22\frac{3}{4}$	6	16	$35\frac{1}{2}$

During the same period the following number of men were employed at the workings of these several localities.

Year.	Nerchinsk region.	Amour province.	Littoral province.	Year.	Nerchinsk region.	Amour province.	Littoral province.
1882	7,225	2,307	290	1887	4,481	1,132	140
1883	6,773	2,969	350	1888	4,010	2,226	203
1884	6,796	2,492	307	1889	4,642	2,701	175
1885	5,683	2,445	293	1890	5,174	2,727	319
1886	5,560	1,997	148	1891	4,431	3,400	551

The method of exploitation and in general the technical side of the gold industry depends upon whether the gold is extracted from alluvial or veinous deposits. In the alluvial

deposits the superficial layer consists of an alluvium known as peat. The thickness of this peat varies considerably and the relation between the thickness of the peat and that of the auriferous alluvium determines the system of working followed for extracting the gold. Before entering upon the actual exploitation of the auriferous beds, exploratory workings are conducted for determining the thickness of these beds and their richness in gold. In those parts of Siberia where the soil is unfrozen, the exploration of the deposit is generally made in the winter by means of pits sunk into the frozen ground. The method adopted is as follows: in antumn the pits are laid out and sunk to the water level, when the work is stopped and the pits left open for a certain number of days depending upon the degree of cold, the depth of the pit and the kind of soil. The pits are carefully protected from snow. When the pit has sufficiently frozen through, a wood fire is lighted at the bottom and when the bottom of the pit has thawed to a depth of about one foot, the thawed layer is easily removed with a pick and shovel. Notwithstanding the severe frosts, the freezing of the pits can only be carried on to a depth of four sagenes. In those localities where the soil is frozen the exploratory pits do not present such difficulties, as they are made in hard ground and without the inflow of water. The specimens of the ground taken for assay from the bottom of the pit are washed in buddles in warm winter quarters erected upon the workings. The assays are taken at about each half foot through the thickness of the deposit.

In the Yeniseisk region the winter exploring parties consist of five men with one overseer, and cost about three thousand roubles. Such a party is able to sink about 150 pits three sagenes deep. The removal of the peat is carried on during the autumn or winter, or else simultaneously with the extraction of the sand, or else slightly in advance of it. If the peat be removed in the autumn or winter a thin layer is left over the gold bearing alluvium to protect it against the influence of the severe frosts, and then this layer is removed in the spring. Sometimes advantage is taken of the spring floods, to wash away a portion of the peat. Only in a few, rare instances is the peat, containing a very small amount of gold, washed throughout its whole extent; as a rule it is carried away and thrown aside. The extraction of the auriferous sand is conducted in the simplest manner possible by means of picks crowbars and shovels. However, in the Olekminsk region the use of explosives in the mining works is yearly increasing, and the annual consumption of dynamite at the gold workings of this region amounts to about a thousand pouds. The auriferous sand is transported to the washing machines in two-wheeled carts drawn by horses, along a natural road or along a road made of logs. In some of the gold regions the transport at certain workings is done in trucks along a tram line. The rare application of mechanical motors and appliances is frequently made a subject of reproach to the Siberian gold workers, but it is necessary to remember not only the situation of the workings in the most remote localities, void of any road capable of transporting heavy weights, but also the entire absence of any mechanical machine or other industrial works in Siberia which could furnish the gold workings with the requisite tools, mechanism, machines or appliances. The carriage of such articles from the Urals is exceedingly expensive and sometimes doubles and triples their cost. Nevertheless, at some of the workings in the Olekminsk region and Amour province, there is a comparatively large application of mechanical appliances in the place of hand labour. This is particularly observable in the workings of

the Amour system, where there are large gold mining companies with sufficient capital at their disposal. Moreover, at many of the workings in the Olekminsk region the sand, gravel and peat is raised and transported by means of chain gear along a tram line. But it should be observed that if tram lines, transport by endless steel ropes, and even Lartig roads are met with in these regions, it is chiefly owing to the extreme dearness of horses and their feed.

The extraction of the auriferous sand is carried on simultaneously with the washing; but in underground mines the sand is prepared for washing in the winter. Experiments made on the application of the hydraulic method of exploitation have not been successful, and there is not much chance of this method being ultimately adopted in the Siberian gold workings, owing to the irregularity of the distribution of the gold bearing properties, which renders it impossible to erect large water reservoirs and hence of having a sufficient pressure of water, without which the hydraulic process is impracticable. The motive power required for the machines used in the extraction of the gold is generally furnished by overshot water wheels. The water is led to the washing machines either by canals or wooden conduits called splotka. The water supply is generally very well constructed and the timber which supports the conduits, in places attains 40 and 50 feet and is constructed with especial lightness and strength. The supply of water to the canals and conduits is generally done by partially damming the streams, and there is no need of accumulating the water in reservoir ponds, as there is an abundance of running water almost everywhere. Portable engines are frequently used at the gold mines of the Olekminsk region and of the system of the Amour. These engines are used when there is not sufficient water for the hydraulic motors.

At the present time in Siberia, the washing of the auriferous sand on a large scale is chiefly done in barrels, and only very clayey sand is treated in pans. In rare instances under particularly favourable conditions, when the profile of the soil is sufficiently inclined and the sand easily washed, it is excavated by hand and cast into a trough in which it is washed. This method, known as the Pakoulevsk process, is a modification of the American sluice process. Mr K. Koulibin, mining engineer, has recently introduced the sluice method of washing in the Urals, and he has modified Wooldear's system to suit the local conditions of Siberia, a system originally projected for the hydraulic process. This class of washing appliances are coming into use in Siberia where they are known as koulibinki.

The first machines used in Siberia for washing the auriferous sands, consisted of pans and wooden barrels with iron fixings inside. The first pans and barrels washed from 3,000 to 5,000 pouds of sand per day; but when the gold industry developed they proved insufficient and therefore their dimensions were enlarged and their construction perfected. All the barrels now used in Siberia belong to one type and only differ in their dimensions. Each barrel consists of a conical seive with one-half inch meshes. These orifices are of equal size down the whole length of the barrel and are distributed in a chess board fashion. The barrel is made of boiler plate iron about one-fourth inch thick. The inside fitting of the barrels generally consists of iron bands placed edgewise. The barrels are revolved, by a special gear put into motion by hydraulic motors or portable engines. The dimensions of the barrels vary from 10 to 17 feet in length. The smaller diameters vary from $3^1/_2$ to $4^1/_2$ feet and the larger, from 4 to 7 feet. Below the barrels

there is an inclined plane, whose upper portion is divided by longitudinal beams into several parts on which there are transversal riffles for retaining the gold.

Besides this, other arrangements such as brushwood or cloth are placed upon the inclined plane, for retaining the finer particles of gold. The length of this inclined plane or sluice is from 30 to 40 feet and it is generally made with a rather steep incline. The water for washing the sand is introduced into the barrel by means of several hoses, sometimes fourteen in number, which direct the water into various parts of the barrel. The water and inside fitting of the barrel grind the sand together in the barrel, the gravel passes only through the wide end, and the slime, through the orifices of the barrel into the sluice.

The washed sand and gravel, the so-called tailings fall through special trapdoors into carts or trucks and are dumped on the waste mounds. The barrel machines are made single or double. At the present time, one barrel can wash from forty to fifty thousand pouds of light sand or twenty-five to thirty thousand pouds of pasty, clayey sand per day. The gold is collected from the sluices twice a day, and either undergoes a preliminary concentration' on so-called «Americans» or else goes straight to the buddles where it is washed free from all foreign matter. The more pasty sands cannot be satisfactorily washed in barrels, and therefore other arrangements are employed in their treatment, the most common being a pan from $8^1/_2$ to 16 feet in diameter having an edge one foot high and covered with a sieve with holes from $^1/_2$ to $^3/_4$ inch in diameter. The sand thrown on the sieve is rubbed by several revolving rows of iron shoes, and washed with water. Under the combined action of the shoes and stream of water, the sand is rubbed together and the finer particles pass through the seive and fall upon a sluice in the same manner as with the barrels. The gravel left upon the seive is let through a special orifice from time to time. About fifteen to twenty thousand pouds of sand can be washed on these pans per day. In both the barrel and pan machines a small quantity of mercury is always supplied near the head of the sluice in order to collect the small particles of gold.

The koulibinka consists of a system of two parallel sluices, on which the sand is washed by its motion in a current of water. The sand and waters enter the chief sluice together. The width of this sluice varies from 2 to 3 feet, according to the amount of water and the extent of the washing; it has an inclination of 5 to 7 inches per sagene. The bottom of the sluice is entirely covered with an iron grating, which assists the washing of the sand and arrests the gold, amalgam and schlich. Transversal cuts five inches wide and covered with an iron sieve with interstices of one inch between the bars, are made along the length of the sluice at distances of 12 to 14 feet. The fine gravel and water fall through these sieves and pass along a small inclined conduit into the second sluice, which is parallel to the first but at a lower level. This sluice is covered with a wooden grating for retaining the gold and amalgam. At its head, this sluice is from $1^1/_4$ to 2 feet wide, and it has a uniform inclination of $3^1/_2$ inches per sagene. This second sluice widens out somewhat towards the bottom, as the amount of sand falling through the cross cuts in the first sluice increases. The first sluice on the contrary is made wider towards the head. In both sluices, a fresh supply of water can be added if required according to the state of the division of the sand. The first sluice terminates in a sieve inclined at 45 degrees over which the coarse gravel rolls into a

hopper, whence it is cast into trucks or carts and carried to the dump. The smaller particles fall through this sieve on the second sluice which here bends underneath the first sluice. The second sluice terminates in a kind of rake arrangement for collecting the fine-washed gravel. The chief condition required in this mode of washing is a sufficient supply of water.

With respect to veinous or quartz gold in Siberia, it is only extracted in the Yeniseisk region, in very small quantities; in the Altai in the exploitation of the silver ores from the Zyrianovsk and Riddersk mines, and in the Transbaikal province, where three deposits are now worked, giving a yearly yield of 12 to 17 pouds per year. The gold ores extracted from these deposits are crushed in stamps and washed in sluices covered with amalgamated copper sheets; the extraction of the gold is extremely imperfect and a large amount is lost. As a portion of the gold is in a state of chemical combination, some experiments were made in 1885 to apply Mounktells process for the treatment of the gold ores at one of the deposits in the Transbaikal province; but they were not successful.

In general, one of the chief hinderances to the development of the exploitation of veinous gold ores in Siberia, is the absence of mechanical works where the necessary machines could be constructed and repaired, as at present such machines have to be brought from the Urals at a great cost. An extended application of the wet chlorine methods of treatment in Siberia, is hindered by the cost of the materials requsite for the production of chlorine from bleaching powder. Apparently the extraction of gold by means of electrolysis would be more profitable in Siberia, as the use of turbines which is already beginning at the gold mines would give the possibility of having a mechanical motor during the whole year and of thus treating a sufficient amount of ore to bring in a profit.

The exploitation of gold over the whole of Russia is carried on upon the basis of the statute of the private gold industry, published in 1870. According to this statute, the gold miners working upon proprietary lands pay a tax upon the yield of gold to the Government, while those working upon State lands or lands belonging to His Majesty's Cabinet, pay an extra royalty to the Government or the Cabinet for the land covered by their workings. The tax upon the yield of gold is levied on the amount of pure gold and silver separately present in the unrefined metal. The gold miners in the Olekminsk region, as the richest, pay a 10 per cent tax and 10 roubles royalty per dessiatine of government land occupied by the workings; in the province of the Amour there is a 5 per cent tax and 5 roubles per dessiatine; in all the remaining parts of Siberia and in European Russia, there is a 3 per cent tax and a rental of 1 rouble per dessiatine per year.

The gold workings on the lands belonging to His Majesty's Cabinet are divided into three classes according to their yield, and they pay a royalty from 5 to 15 per cent to the Cabinet and a rental of 15 kopecks per sagene length of the workings.

All the schlich gold obtained by private individuals in Siberia has to be sent by them to the Government smelting houses, of which there are two, one for Western Siberia at Tomsk, and one for Eastern Siberia at Irkutsk. Besides this, His Majesty's Cabinet, under whose jurisdiction are the Altai and Nerchinsk works, has its own laboratory for the treatment of precious metals. The gold is smelted at the smelting house and its degree of purity determined

by assay. The metal is forwarded to the St. Petersburg Mint, and the gold merchants are given bills by which they obtain gold or silver coin or gold ingots.

Silver, lead and copper.

Siberia was once inhabited by a people, who according to the Russian legends, were called C h u d (wonder men). It is not known when this people lived, but the chief monuments of their former existence are ancient mines, chiefly with open diggings, only in rare instances, underground workings. The antiquity of these works is seen from the fact that all the instruments which have been found in them are made either of copper or hard stone, which leads to the supposition that this people was entirely unacquainted with iron. The Chud mines, as these ancient workings are called, guided the Russian pioneers in their search for metalliferous deposits, and at first, all the workings were begun in those localities where the Chud had formerly extracted their silver, lead or copper.

In Western Siberia the numerous remains of Chud mines found on the Altai and its very name of «altai» which means the «gold mountains» indicate their richness in metals. The first efforts made by the Russians to exploit these riches belong to the close of the XVIII century but, strictly speaking, the mining industry of the Altai was placed upon a firm footing at the beginning of the XVIII century by Akinfla Demidov the son of the Tula blacksmith Nikita Demidov (Antoufiev). In 1723 some Russian hunters found the remains of ancient scoria in the old waste heaps of Chud workings, near lake Kolyvan in the Biisk region, and mentioned this fact to Demidov. The ore deposits discovered in this locality proved to be particularly rich in copper and hence Demidov founded the first copper smelting works in the Altai, as early as 1726. He called these works the Kolyvano Voskresensk works. In 1739 he erected the Barnaoulsk works, which subsequently, in 1771, became the town of Barnaoul and became the administrative centre of all the works of the Altai region. In 1744 Demidov erected a third work in the present Semipalatinsk province on the borders of the Altai region.

In 1735 Demidov discovered the Zmeinogorodsk mine, but it was left unnoticed as the amount of copper in it proved inconsiderable. Soon afterwards however, namely in 1742, rich argentiferous lead ores were found in the Zmein mountains, from which Demidov in 1744 and 1745 obtained 2 pouds $25^3/_4$ pounds of silver. Subsequently, by an Imperial ukaz of the 15th May, 1747, all the mines and works of the Altai passed into the hands of His Majesty's Cabinet.

From that time the mining industry of the Altai made rapid progress. The discovery and laying out of new mines continued to the close of the XVIII century. The following were the chief of these mines: the Cherepanovsk in 1781, the Salairsk in 1781, the Riddersk in 1784, and the extremely rich Zyrianovsk mine in 1791. The following works were erected by the Cabinet: the Pavlovsk in 1763, the Souzounsk in 1764, the Tomsk in 1770, the Loktevsk in 1771, the Aleisk in 1774, and the Ekaterininsk, afterwards called the Gavrilovsk, in 1793. Two more works were erected in the present century, the Zmeevsk in 1804,

and the Gourevsk in 1816. Nearly all the works in the Altai are silver smelting works, the only exceptions being the Tomsk and Gourevsk iron works and the Souzounsk works which smelt copper as well as silver. According to their geographical position all the ore deposits of the Altai mining region may be divided into two independent groups. The first of these groups, the so-called Zmeinogorsk region, lies in the southern portion of the Altai region, in the systems of the rivers Obi and Irtysh; and the second or Salairsk region lies at the north-eastern extremity of the Altai region in the system of the river Toma. The most important difference in the conditions of these two groups is that the works of Zmeinogorsk region exclusively employ charcoal fuel, while those of the Salairsk region being in the near neighbourhood of the Kouznetsk coal basin, work with mineral fuel.

The mountains which contain the ore deposits in the Zmeinogorsk region belong to the branches of the Sayansk mountains; while those in the Salairsk region belong to the branches of the Altai mountains. They generally have the appearance of rounded volcanoes, without any rocky peaks. As a rule the height of these mountains does not exceed 4,000 to 4,500 feet. The predominating rock in these mountains is clay slate, and are more rarely crystaline schists, upheaved by porphyries, which most likely played an important part in the formation of the ore deposits. At the foot of the ore bearing mountains there are strata of sedimentary formations of different periods consisting of slates, limestones and sandstones. The ore deposits belong to two classes, veins and stock works. All the vein deposits bear the general character of steeply inclined, short and thick veins. They generally occur on the borders of the junction of the clay slates with felsite porphyries. The vein deposits of the Salairsk mountains are accompanied by veins of quartose felspar porphyries which in their zone rise to the formation of ore bearing cavities. As a rule, stock works are rare in the Altai, and are only known for the copper deposits and then they are not of great extent.

As many as eight hundred deposits of metallic ores are known in the Altai mining region. Altogether however only about five hundred mines have been exploited, out of which only eight silver and two copper mines are now worked. The silver ores contain a smaller or larger amount of various compounds of copper, lead, zinc and iron, which modify the external appearance, properties and richness of the ores; thus as a rule, those ores which are rich in lead or copper are poor in silver. The copper ores have the most uniform composition. Gold is found in only two of the silver mines, the Zyrianovsk and the Ridersk, and is distributed in a very variable extent throughout the deposit. Generally it appears in dependence upon a decrease in the amount of silver and other metals and occurs sparingly in ore bearing quartz in poor ferruginous silver ores. The metalliferous ores are either ochre or pyritic ores. The ochre ores occur in the upper level of the deposits and were formerly the chief objects of exploitation. As they descend to a greater depth, the ochre ores gradually change into pyritic ores. All the Altai mines, at their greatest depth of 70 to 100 sagenes, pass into a zone of transition of the ochre into pyritic ores, and hence the ore is exceedingly variable in its composition and richness in metal. The ochre ores are generally richer than the pyritic and this distinction is most evident in the case of silver ores; the transition of the ochre into pyritic ores generally has an extremely unfavourable effect upon the richness of the ore in silver and lead; besides which the smelting of the ores becomes much more difficult. For

this reason the existing mines are not in a position to yield the same amount of metal as formerly.

The amount of silver and lead in the ores is subject to great fluctuations. In the ochre ores the amount of silver varies from $^{1}/_{8}$ to 10 zolotniks per poud of ore, and the amount of lead from 6 to 12 pounds per poud of ore, or 15 to 30 per cent. The pyritic ores are very much poorer. The amount of copper in the ores, smelted at the Souzounsk works, is from 5 to 10 per cent. Very many of the silver mines are accounted quite exhausted and therefore their exploitation has been entirely stopped. Among these it is impossible to avoid mentioning the Zmeinogorsk mine, which for a period of some seventy years yielded over 50,000 pouds of silver. Other mines were worked for a much shorted period and after giving several thousand pouds of silver were found to be exhausted.

At the present time the most productive mines are the Zyrianovsk in the Zmeinogorsk region and the Salairsk mines in another portion of the Altai region. The first named now yields about 500,000 pouds of ore, and the latter which, during the eighties, yielded from 700,000 to one million pouds of ore, in 1891 gave only 395,400 pouds. The Zyrianovsk deposit is now considered the most productive of all the deposits of the Altai. It lies in the south-eastern portion of the region on the river Maslianka, 12 versts distant from the left bank of the river Boukhtarma and 70 versts from the river Irtysh. The Zyrianovsk deposit is about 340 versts from the nearest silver smelting works, the Zmeievsk works. The Zyrianovsk deposit has yielded more than 45 million pouds of assorted ore containing over 45,000 pouds of silver and over 2,500,000 pouds of lead.

The Salairsk deposits, which are now exploited by two mines, the Salairsk 1st and Salairsk 2nd, are very thick and extensive and guarantee a supply of ore for smelting for a very long time, but the ores of these deposits are poor in silver. Only two copper mines are now in work, the Sougatovsk and the Chudak. These mines are situated in the southern portion of the region, not far from the Irtysh; but at a distance of 400 versts from the Souzounsk copper smelting works. At the Sougatovsk mine, besides ore, a cement copper is obtained from the mine waters. The ores of the Zmeinogorsk region were smelted at four works, the Barnaoulsk, the Pavlovsk, the Loktevsk and the Zmeievsk, but the first three of these are now closed. The Salairsk region contains the Gavrilovsk silver smelting works.

The statistics respecting the amount of silver smelted at the Altai works, show that at the beginning of the present century over a thousand pouds of this metal were annually smelted during a period of many years. Such was the position of the works at the time of the liberation of the serfs, an event which in 1862 produced a complete revolution in the economic order of the country, and changed the conditions of the mining industry in this poorly populated region. During the first years following the liberation of the serfs, the production of the Altai works remained almost as before, thanks to the energetic production of rich ores from previously prepared workings in the Zyrianovsk and Talovsk deposits. The increased price of labour led to a considerable reduction in the amount of preparatory and exploratory diggings, which had the necessary censequence of gradually decreasing the stores of ore and of subsequently reducing its actual production. The abolition of obligatory labour not only raised the wages at the mines, but also considerably increased the cost of transporting the ore, and this

clearly proved the disadvantages of the great distances between the mines and the works. Moreover, the rise in the price of fuel, owing to the exhaustion of the forests in the neighbourhood of the mines and the feeble development of the mechanical parts of the works, also influenced the position of the metallurgical and mining industries of the Altai. And yet at the end of the last and beginning of the present century, the mechanical portion of the Altai works was placed upon another footing. It is worthy of remark that so early as 1766 a mining engineer Polzounov, erected the first steam acting blowing engine for blast furnaces at the Barnaoul works. Polzounov may justly be called the forerunner of Watt. In the Altai also the first experiment of laying down a tram line was made in 1817, for transporting the ore from the Zmeinogorsk mine and the Zmeevsk works, along a distance of $2^1/_2$ versts.

Owing to the above mentioned causes, the production of silver at the Altai began to decrease considerably, especially since 1868; so also the amount of copper smelted, which in 1872 amounted to nearly 40,0C0 pouds, subsequently gradually fell. The following table gives the production of the Altai mining region during the last ten years.

Years.	Production.			
	Silver.		Lead.	Copper.
	Pouds.	Pounds.	Pouds.	Pounds.
1882	397	$25^1/_4$	14,890	16,800
1883	368	$12^1/_4$	16,385	14,015
1884	446	$29^1/_4$	20,083	24,000
1885	535	$23^1/_2$	16,706	24,605
1886	613	$6^3/_4$	22,079	17,800
1887	661	38	31,117	16,240
1888	682	$4^1/_2$	10,099	18,200
1889	652	$1^3/_4$	6,653	21,073
1890	681	8	19,305	19,337
1891	595	$7^1/_2$	11,188	13,193

In reducing their smelting of silver and lead, the Altai works are adopting a wet process for the extraction of silver from the ores after a method invented by a Hungarian engineer Bittzansky for treating the ores from the Zyrianovsk mine.

In Eastern Siberia old workings of galena in crystalline limestone have been discovered in the government of Yeniseisk in the Minousinsk district at the Irbinsk estate. A large number of Chud mines have been found on the eastern declivity of the Alatau mountains and beyond in the valley of the Yenisei. These workings were renewed in the middle of the seventeenth century and the Lougazhsk copper smelting works were erected here at a distance of 9 versts from the Yenisei and 25 versts from the town of Minousinsk. These works not only smelted ores from the surrounding mines, but also from more distant localities: from

the upper courses of the rivers falling into the river Abacan, and from the Mainsk mine on the Yenisei at the village of Oznachennyi. In 1874 the Spassk copper smelting works were erected on the river Pechits. These works smelted ore from the Mainsk and several other mines. They as far as is known, only worked between 1879 and 1881 and altogether smelted about 1,250 pouds of copper.

Deposits of argentiferous galena are known in the government of Yakutsk at several points along the Vilua and Undybala, the tributary of the river Yana. In 1850 the latter deposit was explored, but it was found unsuitable for exploitation owing to its distance from populated localities and to the scarcity of forests. In all probability this was also the reason why the exploitation of the Undybalsk mine, which was carried on from 1765 to 1775, was afterwards stopped. There is another deposit in the Yakutsk province, on the river Batoma, a right ributary of the Lena, where it is said the native Yakuts smelt lead and silver.

Rumours of the occurrence of silver ores in the present Amour Govenor-Generalship, at Daouria on the banks of the Shilka and Argouna, reached Moscow during the reign of Peter the Great, and induced this monarch to dispatch a party of Greek miners to Siberia under the direction of one Levandian, who in 1698, guided by the discovery of remains of Chud workings on the Koultouchnaya mountain 16 versts distance from Argouna, discovered a deposit of argentiferous lead ore in this locality and began to exploit it. In 1704 silver smelting works, called the Nerchinsk, was erected by order of Peter I. At that time the whole of this portion of the Transbaikalia, which subsequently comprised the Nerchinsk mining region, was a perfectly wild country only inhabited by nomad natives. To introduce a regular mining industry into this region, it was necessary to take measures for the emigration of Russian settlers and to overcome immense difficulties. This explains why at first the mining industry in the Nerchinsk region developed very slowly. But the production of silver began to increase considerably with the opening out of new mines and with the growth of the population in the region.

The introduction of smelting by private Siberians also had a beneficial effect. The maximum production of silver was, during the period 1763 to 1786, when it attained 629$^1/_2$ pouds. In 1790 the yield of silver fell to 219 pouds, it subsequently periodically fluctuated, and in 1847 it even fell below 200 pouds. From that time the production of silver in the Nerchinsk region declined completely, and from 64$^1/_2$ pouds smelted in 1850 it fell to 7$^1/_2$ pouds in 1863, and then it temporarily ceased altogether. The reasons of this fall in the silver production of the Nerchinsk region were the flooding of the mines, the economic revolution produced by the abolition of the serfs and of the obligatory labour at the works, and chiefly the revolution which took place in the management of the Nerchinsk works, with the opening of new and richer gold workings, when all the force and means of the region were directed to the extraction of gold, which became the chief object of production instead of silver and lead. Thus there is no foundation for speaking of the exhaustion of the deposits of silver ore in the Nerchinsk region, and there is reason for supposing that the production of silver might revive with fresh energy, if the economic conditions of the region were improved. As regards the deposits of silver ores, it can only be said that as many as 90 different mines have been opened out in the Nerchinsk region, that vein deposits predominate in the south-western,

and pocket deposits in the north-eastern portion. Besides silver and lead, deposits of copper ores are also known, but although trials were made to exploit and smelt them, the results were not favourable. At the present time altogether 10 mines are worked and their annual yield amounts to 100,000 pouds. The only existing silver smelting works in the Nerchinsk mining region, the Kroutomarsk works, smelt about 50 pouds of silver a year.

A deposit of argentiferous lead ores has been discovered in the far eastern extremity of Siberia, in the valley of the river Vantsin at about 120 versts distance from the gulf of St. Olga, and 37 versts from the gulf of Preobrazhensk. Explorations of this deposit, made in 1872, showed the presence of rather vast, ancient workings, and in recent times the exploitation of the ores was carried on by the Chinese.

Traces of Chud mines are found scattered about various parts of the region of the Kirghiz steppes, and in 1815 and 1820, these workings were the means of the discovery of rich deposits of argentiferous lead ores. A mining proprietor, Mr. Popov, guided by the indications of the natives, made the first claim for deposits of argentiferous lead and copper ores in the Kirghiz steppes and obtained a concession for the acquirement of what lands and forests he might need for the exploitation of the mineral wealth of the region and for the erection of metallurgical works. Already in 1857, 106 copper workings and 44 argentiferous lead and copper ore mines were declared; and at the close of 1888, the Karkaralinsk district of the Semipalatinsk province, comprised 121 claims of ore deposits, both copper and argentiferous lead; while in the whole of the Kirghiz steppes up to 400 ore bearing deposits are known. The following are the most important. The richest argentiferous lead ore deposits are situated in the southern portion of the Karkaralinsk district between the town of Karkaralinsk and lake Balkhash, at a distance of 200 to 250 versts from the above named town. This locality is desert and void of forest and at a great distance from the river Irtysh which is the only convenient means of communication in this region.

There is another tract of argentiferous lead and partly argentiferous lead and copper ore deposits, to the north of the above region at a distance of 75 to 100 versts from the town of Karkaralinsk to the south and south-west of this town. Among the many vein deposits of this district which have been opened out, the vast deposit of Ber-Kara is particularly distinguished. The Bogoslovsk mine was laid out on this deposit by Popov and worked to a depth of 18 sagenes. This mine yielded both argentiferous lead and copper ores, which were smelted at two works erected by Popov, and also at the Altai works to which they were temporarily transported. Deposits of copper ores are particularly abundant on the borders of the Karkaralinsk and Pavlodarsk districts. Many of these deposits occur in the form of veins of greater or less thickness, and in some instances somewhat considerable masses of native copper have been found. The copper ores extracted from this region were smelted at copper smelting works erected in the neighbourhood. Oxidized copper ores are found in the sandstone strata occurring to the south of the town of Semipalatinsk in the basin of the river Aschi-Sou, and in the north-western corner of the Karkaralinsk district, near the borders of the Akmolinsk province in the lower courses of the river Chiderta.

Copper smelting was first started in the Kirghiz steppes, at the Blagodato-Stefanovsk works, erected by Popov at about 80 versts distance to the north-east of the town of Karka-

ralinsk. These works continued in action until 1861, when they were finally closed for want of fuel. Popov also erected the following metallurgical works: the Alexandrovsk which exclusively smelted argentiferous lead ores, and were situated at a distance of 35 versts to the north of the Bayan-Aoulsk station; the Bogoslovsk works, in the centre of the richest deposits of argentiferous lead and copper ores, on mount Berkara at 80 versts distance to the south of Karkaralinsk; and the Ioanno-Predtechensk works near the Kyziltavsk coal mines. All these works, as well as those erected by Mr. Kouznetsov near the Grachevsk station, on the left bank of the Irtysh, had no guarantee for their supply of fuel, aud only worked intermittently, and their annual yield of copper did not exceed 8,000 pouds.

The Spassk copper smelting works were erected by the heirs of Mr. Ryazanov in the beginning of the sixties, in the district of Akmolinsk near the borders of the Karkaralinsk district, and from that time the copper production of the Kirghiz steppes considerably increased, and in 1870 reached its highest normal of 38,800 pouds. During the entire period of the existence of the Spassk works, which were closed in 1885, the production of copper, at the Kirghiz mines varied between 18,500 and 34,000 pouds per year. After the closing of the Spassk works however, the Kirghiz steppes lost every importance among the copper producing regions of Russia.

The production of silver and lead at the Kirghiz works was carried on very irregularly, and in very limited quantities until 1883. In 1882 a rich and already known deposit of galena and oxidized lead and copper ores was explored at Kyzyl-Espe, situated in the Akchetavsk district, at a distance of about 80 versts to the north-north-west of lake Balkhash. An experimental smelting of these ores was begun in 1883, at the works erected at the mine, and also at the Kozmo-Demyanovsk works situated at 18 versts to the south-east of the town of Karkaralinsk, and 280 versts from the mine. The galena and lead ores extracted from the Kyzyl-Espe mine proved exceedingly rich, with about 12 zolotniks of silver per poud of ore and about 50 to 70 per cent of lead.

In recent years the production of silver and lead has not only increased at the works erected by Popov, but experimental smeltings have been carried on at several other mines belonging to other persons.

The following table shows the position of the silver and lead production in the Kirghiz steppes since 1883.

Years.	Production of silver.		Production of lead.	Years.	Production of silver.		Production of lead.
	Pouds.	Pounds.	Pouds.		Pouds.	Pounds.	Pouds.
1883	—	33¼	—	1888	136	8	22,544
1884	10	27¾	2,693	1889	110	10½	10,836
1885	35	2¼	3,186	1890	72	28¼	14,693
1886	84	23½	8,937	1891	96	13¾	3,879
1887	171	16¼	11,363				

Iron.

At the present time there are only four iron works in the whole of Siberia. It is true that, thanks to the vast river system offered by the Toura, Tobol, Irtysh, Obi and Tomi, up to the town of Tomsk nearly the whole of Western Siberia is in direct water communication with the very foot of the Urals, and can conveniently supply itself with metals from this centre of the Russian mining and metallurgical industries where there are most vast and rich deposits of iron ore, and numerous iron works. On the other hand, the system of the Amour enables goods transported by sea from Nikolaevsk to penetrate over 3,000 versts into the interior of Siberia. It is certain however that notwithstanding the cheapness of transport by water, the vast distances traversed must greatly increase the price of goods carried in this manner. At the same time the population of Siberia are in need of pig-iron and iron as well as of articles made of these metals, not only for domestic and agricultural purposes but also for the vast gold industry which offers a more and more urgent demand for metals and metallic goods. If up to the present time the iron industry is still very feebly developed in Siberia, it is not for want of ore deposits but for purely economic and commercial reasons. It should be mentioned however that the deposits of iron ores near the town of Yeniseisk were worked by the native Ostiaks and Toungouze previous to the Russian dominion of Siberia, and afterwards by the neighbouring peasants. The manufacture of iron direct from the ore, which was carried on here from ancient times, flourished to such an extent that at the beginning of the present century there were as many as forty smithies which yearly produced about 30,000 pouds of iron. The development of the gold industry however absorbed all the local labour and put an end to this branch of industry.

The erection of iron works within the Altai mining region was called forth by the requirements of the local mining and metallurgical industries. The first iron works, the Tomsk, were erected in the Altai in 1771, to replace the Irbinsk works, which were for a certain period under the jurisdiction of the Altai mining management but situated at a considerable distance in the government of Yeniseisk. After the erection of the Gourievsk works in the Kouznetsk region of the government of Tomsk on the river Bachata, for smelting the silver ores of the Salairsk mines, some deposits of iron ores were discovered in the near neighbourhood of the works, and a small blast furnace was erected for smelting the ore. In 1846 this furnace was replaced by one of greater dimensions and in 1847 the Gourievsk iron works were erected on this spot. The Tomsk works were closed in 1864 and the manufacture of iron was then concentrated at the Gourievsk works. The increased cost of charcoal fuel, owing to the exhaustion of the neighbouring forests, induced the works, in 1873, to introduce coal and to replace the bloomery process for puddling. At the same time the increasing demand in the region for machines and steam engines led to the erection of special machine works, adjoining the Gourievsk works, and the production of this department is increasing every year. The ore smelted at the Gourievsk works is a brown hem-

atite, extracted from the deposits, lying near the villages of Salairsk Roudnik and Aripichevo; both these deposits are considered very rich. The ores contain from 38.5 to 44.3 per cent of iron. The coal consumed at the Gourievsk works is from different pits situated at a small distance from the works. Coke is made from coal from the Bachatsk deposit. Limestone flux, fire clay, building stone and other indispensible materials for carrying on works, are exploited in the near neighbourhood. Nearly all the workmen employed at the works are local inhabitants. The following table gives the production of the works during the last six years in pouds.

Years.	Pig iron smelted.	Manufactured.		
		Iron.	Iron goods.	Iron castings.
1886	123,980	72,220	6,570	5,000
1887	133,300	44,040	5,500	4,820
1888	70,880	60,825	5,675	8,080
1889	99,010	50,630	4,300	8,900
1890	115,960	60,130	2,230	9,300
1891	126,020	63,230	6,163	10,830

The excellent quality of the iron ores discovered in the Minousinsk region of the government of Yeniseisk, led to the construction of two iron works in this district. The Irbinsk iron works were erected by the Government as early as 1740, on the right bank of the Yenisei at a distance of about 100 versts to the north-east of the town of Minousinsk. In 1774 the Irbinsk works were given over to a private individual and after passing from one hand to another, they became quite disorganized and were ultimately closed. A rich deposit of magnetic iron ore is known within the limits of the 125,000 dessiatines of forest belonging to these works. Another locality, rich in iron ore, occurs in the south-western corner of the government of Yeniseisk, where the spurs of the Altai and Sayansk mountains hinder the rapid course of the river Abakana, which falls into the Yenisei, at several versts from the borders of the government of Tomsk, and 80 versts from the northern frontier of China.

A Moscow merchant Mr. Kolchougin was the first to penetrate into this district, in 1865, and having discovered a rich deposit of iron ore on the left bank of the river Abakana, at about 200 versts distance from its junction with the Yenisei, he erected the Abakansk iron works on the spot. The explorations made here showed the presence of thick deposits of magnetic, and spathic iron ore and of brown hematite. The vast thickness of this deposit and the huge store of ore it contains can be seen from the fact that it extends for a distance of about a verst and intersects an entire mountain about 60 sagenes high from foot to summit. These ores contain from 61 to 65 per cent of metallic iron, and give on smelting from 50 to 60 per cent of pig iron; moreover they are very easily smelted.

The Abakansk works smelt with charcoal fuel, which it procures from the 117,000 dessiatines of forest attached. The erector of these works founded a village in their neighbourhood, which he populated with workmen from the various Ural works. Besides the people regularly employed there the inhabitants of the neighbouring villages and natives are attracted by the auxiliary and other labour, offered by the works. Owing to the bankruptcy of the proprietor these works are now exploited by an artel or company of local workmen, who not having sufficient capital or labour for carrying on the business in a proper manner, only keep it going in a very small way. And yet the technical conditions offered by the rich stores of excellent ore, the possibility of applying water power, the good quality of the articles turned out, which in no way cede to those of the Ural works, and also the profitable economic conditions presented by a contingent of experienced workmen and a vast region for sale opened to the works by means of water communication, all this proves the possibility of reviving the activity of the Abakansk works on a perfectly new footing.

The following table gives the production of these works in pouds, during the last 6 years.

Year.	Pig iron smelted.	Manufactured.		
		Iron.	Iron goods.	Iron castings.
1886	73,300	65,650	—	3,200
1887	70,530	75,800	4,400	4,260
1888	41,830	17,790	3,095	2,020
1889	13,770	7,920	1,330	8,710
1890	74,160	52,250	5,050	2,820
1891	124,770	82,740	6,940	5,900

The Nikolaevsk iron works are situated in the government of Irkutsk on a tributary of the river Oka, which falls into Angara, and at a distance of 600 versts from Irkutsk, and 180 versts by road from the town of Nizhneoudinsk. These works were erected by the Government in 1845, and in 1864 passed entirely into the hand of Mr. Trapeznikov, a merchant. The new proprietor devoted about a million roubles to this affair, and raised the yield of the works; but being occupied in other matters he was obliged to sell them in 1870 to Mr. Lavrentiev, also a merchant, who in his turn after two years, sold the works, mines and plant to the brothers Boutin, merchants of Nerchinsk. The works own several iron mines situated at distances of 4 to 90 versts. The ore, a magnetic iron ore, gives from 40 to 55 per cent of pig iron.

The works have 48,840 dessiatines of forest attached to them. The motive power is partly hydraulic and partly steam. The population of the works now numbers 3,500, including 700 to 800 workmen. The production is inconsiderable and does not even suffice for the near neighbouring demand.

Their yield during the last six years was as follows, in pouds. In addition to this the Nikolaevsk works manufacture steel, only in very limited quantities.

Year.	Pig iron smelted.	Manufactured.		
		Iron.	Iron goods.	Iron castings.
1886	213,900	82,040	29,570	27,570
1887	153,060	70,230	22,940	29,050
1888	150,470	96,950	24,840	31,250
1889	·163,450	103,650	25,000	38,600
1890	204,760	121,370	24,870	35,430
1891	203,480	108,630	28,450	33,630

The Petrovsk works, belonging to His Majesty's Cabinet are situated in the Transbaikal province in the Verkhneoudinsk region along the river Baliaga, a tributary of the Khilok, which falls into the Selenga, and at a distance of 450 versts from the provincial town of Chita. The Petrovsk works were founded in 1789 for supplying pig iron and manufactured iron to the Nerchinsk works and for satisfying the demand of the State and private individuals in Eastern Siberia. The ore is extracted from the Balyaginsk mine, on the upper courses of the river Balyaga. It is a magnetic iron ore and is very plentiful. The pig iron is smelted with the aid of charcoal fuel, furnished from 80,000 dessiatines of forest attached to the mines. The works employ about 300 men. The motive power is mainly hydraulic. The production of these works is exceedingly limited and their produce can only satisfy the local requirements of the region.

The following table gives the production of the Nerchinsk works during the last six years, in pouds.

Year.	Pig iron smelted.	Manufactured.		
		Iron.	Iron goods.	Iron castings.
1886	68,860	5,040	3,900	4,890
1887	44,640	7,250	2,680	610
1888	31,920	10,420	3,210	3,240
1889	36,320	26,950	2,770	2,330
1890	43,500	31,050	2,940	1,635
1891	59,085	30,140	3,045	1,830

Lastly it should be mentioned that iron ore deposits are known in many parts of the Yakutsk province, and that the Tanginsk iron works were erected at 30 versts distance from the town of Yakutsk as early as the XVII century, and continued in work until the end of the XVIII century. Besides, the preparation of iron direct from the ore was carried on at other places, and there was also an iron works near lake Baikal on the river Anga. At the present day the exploitation of the ore and its conversion into iron is only carried on by the Yakuts as a village industry. The most important deposits occur on the river Batoma, which falls from the right side, into the Lena. The ore, a brown hematite, here lies in a bed up to three feet thick and has been under exploitation since 1750. Other deposits of iron ore, including red and brown hematite and spathic iron ore, are also worked by the Yakuts in this province but have not been subject to any detailed exploration. The spathic iron ore deposits occur on the river Vilua.

Apparently a rather rich deposit of iron ores occurs in the southern portion of the Littoral province at 20 versts distance from the gulf of St. Olga along the system of the river Avvakoumovka which falls into this gulf.

Tin, Mercury and Sulphur.

The presence of tin ores was discovered in the Transbaikal province along the river Onona in the year 1811. These ores had long been exploited and smelted by the native Bouriata. These first discoveries gave rise to a search for tin ores in other localities along a distance of 100 versts, along both banks of the Onona. A mine was started, the tin ore was exploited from time to time and the ore smelted on a small scale during a period of about thirty years. In 1843 this mine was ultimately closed, but this does not argue that the deposit is unfit for working, and there is reason for thinking that if it were more thoroughly explored it would be possible to reestablish the exploitation of the ore.

The Ildikansk or cinnabar deposits in the Nerchinsk region lie in the mountains on the right side of the river Sernyi Ildekan. The cinnabar occurs in a vein passing through limestone, but its thickness rarely exceeds two inches. The exploitation of this vein was started in 1759 and was subsequently renewed several times, but without success. It may also be mentioned that the Yakuts living along the upper courses of the river Amga which falls into the river Aldan, a right tributary of the Lena, employ cinnabar found by them in the system of this river, as a medicine.

A deposit of native sulphur occurs in a limestone mountain at a distance of $1^1/_2$ versts from the above mentioned Ildikansk mercury deposit. Between 1789 and 1797, 425 pouds of sulphur were extracted from this deposit. Sulphur in the form of sulphur pyrites is extremely common in the metamorphic schists, covering vast areas in Eastern Siberia. The pyrites are disseminated in the schists, or occur in quartz veins intersecting the schists, or also form cross veins. Besides this, spheroidal concretions of sulphur pyrites are frequently found in the brown coal deposits along the river Kempendzyai, a right tributary of the Viluya. The exploitation of pyrites has not yet been carried on in any part of Eastern Siberia. In Western

Siberia from 150,000 to 200,000 pouds of pyrites are annually raised from the Sougatovsk mine in the Altai mining region.

Coal.

Deposits of coal are known throughout the whole extent of Siberia, from the borders of the government of Orenburg to the mouths of the Lena, Kamchatka, island of Sakhalin and the frontier of Corea. At the present time coal is only worked in Kouznetsk basin, on the island of Sakhalin and on the Khirgiz steppes. It is also proposed to exploit the recently discovered and explored deposits of coal in the southern portion of the Littoral province. In the mean time the varied application of mineral fuel obliges one to think that the Siberian Railway will give rise to the exploitation of coal in various parts of Siberia, before it materially effects other branches of mining industry; and the railway itself will be in need of mineral fuel, especially in those localities where it passes through forestless steppe regions.

The following data treat upon the coal deposits in different parts of Siberia. In Western Siberia there are rich coal seams in the eastern portion of the Altai mining region in the Salairsk and Alatau mountains. This is the so-called Kouznetsk coal basin. The southern limit of this basin lies at about 60 versts distance to the south of the town of Kouznetsk; its eastern boundary extends along the western declivity of the Alatau mountains; its western boundary stretches along the eastern foot of the Salairsk mountains, but in places recedes from it and approaches the river Ina which falls into the Obi. The river Toma divides the basin along its length into two parts, and as strata, similar to those in which the coal seams lie in the neighbourhood of Kouznetsk, are also found along the banks of the river Toma up to the very town of Tomsk, it may in all likelihood be supposed that the coal basin extends to this town. Hence the entire basin should be 400 versts long and 100 versts wide, which equals an area of 40,000 square versts. In many parts of this basin, thick seams of coal of excellent quality are found. The coal formations belong to the Jurassic system.

The Telbessk iron mine is situated on the south-eastern border of the Kouznetsk basin, on the river Telbes which falls into the Kandoma. This mine is estimated to contain a store of 75 million pouds of magnetic iron ore; and close to it there is another iron mine, the Soukharinsk. Such an abundance of iron ore, capable of guaranteeing a supply to a large iron works for a long period, induced the local mining management to make a careful survey of this south-eastern corner of the Kouznetsk basin, with a view to the discovery of coal veins in the neighbourhood of these iron mines. These surveys were crowned with perfect success and gave the following results. A seam of coal one sagene thick was found on the left bank of the Kandoma at a distance of 5 versts from the village of Kaltansk. This seam was followed along its strike for 380 sagenes, and it was estimated to contain 8,300,000 pouds of coal. The first Kinerkinsk seam is situated on the left side of the river Kinerka which falls into the Kandoma, above the village of Kaltansk. It has been followed for a distance of 163 sagenes, is 4 sagenes thick and dips at an angle of 22°. The store of coal has been estimated at 16,400,000 pouds. The second seam is on the hanging wall of the first at

35 sagenes distance from it. It is one sagene thick and has been followed for a distance of 75 sagenes. It is estimated to contain 2,250,000 pouds of coal. The third seam, 9 feet thick, is 50 sagenes from the hanging wall of the second.

The first Varlamovsk seam is situated on the southern declivity of the Kirchiaksk mountains, lying on the left bank of the Kandoma, near the village of Kirchiaksk. The thickness of the seam is one sagene, and it dips at an angle of 18°. The seam has been followed for a distance of 210 sagenes; and is estimated to contain 5,515,000 pouds of coal. The second seam lies on the hanging wall of the first. Its thickness is $4^1/_2$ feet, and it has been followed for a distance of 100 sagenes; it is estimated to contain 2,115,000 pouds. The Kirchiaksk seam lies on the northern side of the western end of the Kirchiaksk mountain. It is up to 7 sagenes thick and has a dip of 29°. On the northern declivity of the same mountain there are seven seams of coal, known by the name of the «Ozernyi» or lake seams, owing to their situation on lake Kirchiak. All these seams form one series, lying in a schistose clay. They include one seam $4^1/_2$ feet thick; two, one sagene thick; and three, 2 sagenes thick. They have not been followed up for more than 100 sagenes, and have been estimated to contain over $12^1/_2$ million pouds of coal. The Araldinsk seam outcrops at the bank of the river Aralda, which falls into the Kandoma on the right, opposite the village of Kirchiaksk. This seam is over 6 sagenes thick and has a dip of 18°. It has been explored for 120 sagenes along the strike, and it is estimated to contain 18 million pouds of coal. It is calculated that all the seams situated in the neighbourhood of the village of Kaltansk contain a store of over 65 million pouds of coal.

Further in the eastern portion of the basin, coal seams have been discovered in the neighbourhood of the town of Kouznetsk, on the banks of the river Toma, near the village of Artamonov above the town, and below the villages of Ilinsk and Shorokhova.

Exploratory workings have been carried on in the south-western extremity of the basin near the villages of Berezova and Kostenkova. The workings made near the village of Berezova showed that there the coal seams appear in the form of four separate series, at short distances from one another. The first series consists of four seams, from $2^1/_2$ to $11^1/_2$ feet thick. The second is composed of two seams $3^1/_2$ and 7 feet thick. The third series includes eight seams from $2^1/_2$ to $8^1/_2$ feet thick, and lastly the fourth series consists of four seams from $2^1/_2$ to 5 sagenes thick. In exploring these seams four of the thickest beds were followed up for a distance of 70 to 2,000 sagenes along the strike, and along the dip to the level of the river Berezovka only, and over 210 million pouds of coal were determined. Three seams of coal, one of which is $2^1/_2$ sagenes thick, have been discovered to the east of the village of Berezova, on the banks of the river Kandalena. A whole series of seams closely resembling the four series of the Berezovsk veins, has been found at two versts distance to the north of the village of Kostenkova on the river Kozlovka. This series consists of nine seams from 3 feet to $4^1/_2$ sagenes thicks. Four seams have been explored for a distance of about 400 sagens and are estimated to contain a store of $40^1/_2$ million pouds of coal. In general the coal fields of the south-western extremity of the basin, near the villages of Berezovka and Kostenkova, contain a store of over 250 million pouds of coal. The Magansk coal field has been found at five versts distance to the east of the village of Prokopievsk, to the north of Berezova, on the left side of the river Maganak

This deposit consists of one vein three sagenes thick. The coal from this seam gives a good coke, which has been successfully used in metallurgical operations.

As the above estimate of the stores of coal contained in the different seams only refers to the outcrop of those lying above the level of the river, and the lower levels of those veins were not included in the calculation, and as moreover, in the majority of cases, the strike of the seams was only followed up for an inconsiderable distance, so there can be no doubt that the actual stores of coal in this southern portion of the basin must be many times greater than the above cited figures, and this portion of the basin with its inexhaustible stores of fuel lying in close proximity with the richest deposits of magnetic iron ore, may surely have a great industrial future.

The Afoninsk coal field lies near the village of Afonin and at a distance of 60 versts from the Tomsk works, on the one hand, and from the Gourievsk and Gavrilovsk on the other. Three coal seams have been found, one of which has been destroyed by an underground fire, and all that remains is a bed of ash $1^1/_2$ sagene thick. The second seam, situated on the hanging wall of the first, is about $1^1/_2$ sagenes thick, consists of a bitumenous coal of good quality and was explored to a small depth in 1851. The third seam is thin and has not therefore been explored.

The Bachatsk coal field is situated to the north-east of the village of Bachatsk at 27 versts distance from the Gourievsk works. This seam is not of uniform thickness throughout, but narrows in some parts and widens in others, and in some places is as much as 25 sagenes thick. In some places it is intersected by bands of schistose clay, which divide it into several separate seams. It has a dip of 65° to 75° and is sometimes almost vertical. The coal varies greatly in quality in different portions of the seam; in the centre it is a dry, non-caking, dense, dull coal, which burns almost without any flame; while towards the roof and floor it is a semi-bitumenous, friable, bright, caking coal, burning with a flame. Five coal seams have been discovered to the north of the Bachatsk coal mine, on the river Cherta. These seam vary from $^1/_2$ to 1 sagene in thickness and have been explored by workings for three versts distance. The same seams which appear in such abundance in the southern portion of the basin, outcrop in the north along the Great and Little Bachat rivers. Deposits of coal were discovered along the river Ina as early as 1796. The first of these deposits was found to contain two beds $^1/_2$ and 1 sagene thick, and the second deposit to consist of one seam 1 sagene thick. In the latter, the surrounding sandstone rock contains portions of trees, and even entire fossil trees, 1 to 2 feet in diameter. The Bachatsk and Kalchouginsk deposits are the only ones which are now under exploitation. The coal is converted into coke and consumed at the Salairsk works.

The following table gives the yield of these mines during the last five years.

Year.	The Bachatsk mine.	The Colchouginsk mine.
1887	485,600	322,200
1888	640,900	369,500
1889	530,750	364,700
1890	547,300	504,300
1891	505,650	642,768

During the last three years the following amounts of coke were produced.

Year.	At the Bachatsk mine.	At the Kolchouginsk mine.
1889	273,254	37,456
1890	340,900	71,750
1891	328,766	91,000

In Eastern Siberia, coal fields occur in the government of Yeniseisk, between Krasnoyarsk and Achinsk, on the one hand; and from Krasnoyarsk, through Kansk to the borders of the government of Irkutsk on the other hand, and lastly, to the south-west and south of Krasnoyarsk along the foot of the Alatau and uplands of the Sayansk mountains. The vast areas comprised by these deposits belong to fresh water formations of the jurassic system. The vast tracts of these deposits have only been more or less explored along the Siberian postal route and along certain rivers, but even these explorations have already shown the presence of a rather considerable number of spots with outcrops of brown coal. A seam of coal about five feet thick has been found near the village of Koubekova at about 20 versts distance from the town of Krasnoyarsk along the river Yenisei. Two coal fields have been recently explored on the middle and lower courses of the river Choulym. In the first of these, the seams of brown coal and combustible schist crop out at the surface in several localities along the river Choulym, and were discovered at 20 versts distance from the village of Kourbatovsk.

In the second, the coal veins crop out directly on the banks of the rivers Serega and Ourup, and of several springs near the village of Antropova. A seam of brown coal 2 sagenes thick has been discovered at the village of Nazarovsk on the river Adadyma, and a seam 5 feet thick near the village of Kadat. The formations of this basin have been recognized as belonging to the tertiary system and the coal in them is distinguished from that of the jurassic system, by its greater density. This tertiary coal basin deserves the greatest attention of all the coal fields of the government of Yenisei, both from the quality of its coal the character of its seams, and by its distribution on the navigable portion of the river Choulym. Mount Izykh rises in the Minousinsk region on the right bank of the river Abakan at about 55 versts distance from its jnnction with the Yenesei and the thick beds of sandstone forming this mountain contain seams of coal half a sagene thick and more. Another locality in the Yeniseisk government, which is known to contain beds of coal, lies much farther north, namely on the banks of the Nizhnaya Toungouzka. The presence of coal here was known in the last century. At the beginning of the sixties of the present century, Sidorov during his expedition for making a detailed exploration of the deposits of graphite previously discovered by him in this locality, also visited the Nizhnaya Toungouzka, where he succeeded in discovering vast beds of coal in several localities, at a distance of 240 to 400 versts about the mouth of this river. The first of these beds was discovered opposite the mouth of the Malaya Scherbachikha otherwise known as the Abramova Scherbachikha, which falls into the Nizhnaya Toungouzhka

from the right side at about 240 versts from its mouth. The thickness of the coal seam is 3 feet and it is of good quality.

The second deposit was discovered opposite the mouth of the river Troubkina which falls into the Nizhnaya Toungouzka from the right side at a distance of about 400 versts from its mouth. The coal seam is $3^1/_2$ feet thick and extends for a distance of one verst; the coal is of good quality. The third deposit of coal was found at a distance of 40 versts from the mouth of the river Taimour, which falls into the Nizhnaya Toungouzka. This deposit consists of two seams, the lower of which is one sagene thick. A fourth deposit of coal was found on the right bank of the Nizhnaya Toungouzka at 185 versts from its mouth and about 5 versts above the mouth of the river Koupalnaya. The coal of these seams frequently approaches anthracite in its quality, and in many places the stratification is greatly distorted by trap rocks and the coal transformed into graphite.

In the government of Irkutsk, coal which is for the greater part brown coal, is known in many places in the southern portion of the government, where fresh water formations of the jurassic system occur. The coal seams which are two feet and more thick at the outcrop, lie among strata of schistose clay and yellow calcareous sandstone. At the present time up to 75 outcrops of coal are known in the southern half of the government of Irkutsk. Many of these seams deserve attention, either for their thickness or for the quality of their coal. Prospectings for coal have frequently been carried on in the neighbourhood of the village of Ousolie, with a view to furnishing the Irkutsk salt works with fuel. In these explorations coal seams up to $3^1/_2$ feet thick were, amongst others, discovered. But in all probability the greatest importance will be ascribed to the deposits of coal along the river Oka; above the village of Ziminsk where a whole series of coal seams from 1 foot to 1 sagene thick outcrop on the high right bank of the river. Small exploratory works showed the presence of a store of 200 million pouds of coal in two places. It is a brown coal, with a large percentage of volatile matter, and it gives a powdery coke. After exposure to the atmosphere it, for the greater part, disintegrates into small peices, and resembles the coal of the Moscow basin in its qualities.

In the Yakutsk region, coal-bearing deposits occur along the whole middle course of the Lena and its tributaries and beyond, up to the lowlands of the Lena. Various modifications of this formation stretch out from the river Bolshaya Botama to the village of Bouloun, which is at a distance of about 100 versts from the mouth of the Lena; or for a distance of 1,800 versts down that river. These formations are also observable on the one side of the Lena, on the banks of the river Viluya, beyond the mouth of the Markha which falls into it, for a distance of 600 versts;. and on the other side of the Lena, on the banks of the river Aldan, beyond the mouth of the Maya, for a distance of 400 versts, and from the town of Yakutsk to the north-east within 100 versts of the Verkhoyansk mountain chain, which also forms over 400 versts. With respect to the geological period of these deposits, they, like those of the government of Irkutsk, are considered as belonging to the jurassic system. Coal has been found in the far eastern extremity of Siberia, on the shores of the Gizhiginsk and Penzhinsk bays, and in several localities on the western shore of the peninsula of Kamchatka.

In the Amour Littoral region, coal deposits occur beyond the Baikal, directly on the south-eastern shore of this vast reservoir. Here at eight versts distance from the Posolsk monastery there are two coal seams, between the rivers Kourkoushevka and Pereemna. The upper seam, which is $1^1/_2$ sagenes thick, is broken up into thin seams and contains the stems and roots of fossil trees. The lower coal seam, which lies two sagenes below the upper, on a level with the water, consists of a denser coal. The coal of this deposit is worked for supplying the Baikal steamboats with fuel, but the production is very limited. Besides this deposit, coal has been discovered near the Baikal, at the mouth of the river Mourin. The presence of coal seams is also known between Verkhneoudinsk and Selenginsk on the banks of lake Gousinyi; and the traces of their having been burnt are still in the superincumbent strata of sandstone and schistose clay. The occurence of coal was discovered in 1858, on the river Ourya, which falls into the Aksha, a tributary of the Onon. This is a lignite coal, which in some places still exhibits a tree structure. The Douroisk and Chalbouchinsk deposits on the river Argouna are situated at a distance of 160 versts from one another. The Chalbouchinsk deposit was discovered in 1742. Both of these deposits have been frequently explored, but the extent of neither has been accurately determined. The Douroisk deposit is situated on the bank of the Argouna, 15 versts below the Koulassatouev frontier station. A seam of good quality coal $3^1/_2$ feet thick is known here. Should subsequent explorings show that this coal seam has a considerable extension, then it might acquire a great importance, as it is situated on the very bank of the river Argouna, along which the coal could easily be transported to the Amour.

Numerous exploratory workings, carried on since the middle of the last century, have shown the presence of several coal seams in the Chalbouchinsk deposit; but the small thickness of these seams and large amount of ash and sulphur pyrites in the coal, deprive it of any great importance.

Besides these deposits, seams of brown coal of recent formation occur in the Transbaikal on the upper courses of the river Onon, and also on the Shilka below the Shilkin works. The occurrence of coal is known on the river Zea on the parallels of Albazina and on the Belyi hills opposite the mouth of the Silindzha. From three to four coal seams crop out on the river Boureya. These seams are vertical owing to the extreme distortion of the entire stratification. Each of these seams is from one to two feet thick, and. the coal is of good quality. The coal is interstratified with sandstone and clay slate, the latter of which bears distinct prints of conifer vegetation, showing that the formation belongs to the jurassic system. The same strata of sandstone and clay slate with interlayers of coal up to 1 foot thick, are found at a distance of 150 versts from the above mentioned outcrops, in several localities up to the mouth of the Numan.

Among the very many coal deposits on the middle courses of the Amour, the most remarkable is that discovered at a distance of 9 versts above the station of Innokentievsk, where two seams of brown coal can be followed up for a distance of two versts. These seams lie between beds of sandstone and hard, yellowish gray clay. The coal seams are from 3 to 5 feet thick. This coal consists of the remains of conifer trees, and the superincum-

bent clay contains numerous remains of leaves, fruits and other portions of plants, which often are very like the now existing plants; from which it may be concluded that it is of very recent formation and belongs to the tertiary system. Seams of brown coal also occur at several points along the lower course of the Amour at a short distance from its mouth. These seams occur in strata of sandstone and clay slate, exactly similar to those in the upper course of the Amour. A deposit of brown coal has been discovered at a distance of 160 versts from the town of Nikolaevsk, near the village of Novo-Mikhailovsk, up the Amour. The thickest of the seams in this deposit is $5^1/_2$ feet. Seams of brown coal, up to 1 foot thick, also occur at several points along the lower course of the Amour. The South-Oussouryisk region also contains beds of coal in many places. The first discovery of coal in this region was made at the time of its occupation by the Russians, at the Possietsk's gulf, where there are three seams of coal, the thickest of which is 4 feet. Coal was extracted from these deposits in the sixties to supply the Siberian flotilla. The following coal beds occur to the east of Possietsk's gulf.

Beds of coal have been discovered in the basin of the Amour along the rivers Sedima, Mangougai and Ambabira and at the mouth of the river Souifouna. Moreover coal seams are also known up the river Souifouna, on its right tributary, the Chingoouza, in the neighbourhood of the village of Nikolsk and in the upper courses of the river near the stations of Konstantinovsk and Fadeevsk. The exploitation of the coal in various localities on the mouth, Souifouna, was begun in the sixties and is being continued to the present day. In the Oussouryisk gulf, coal beds have been discovered on the river Tsimou-khe, at the mouth of the river Kangoouza and on the river Shite-khe. Coal is also known to occur on the island of Poutiatin and on the north-eastern shore of Strelok bay. Vast deposits of coal have been discovered 40 versts up the river Souchan, which falls into the gulf of America. In 1886 a special mining expedition was sent there and the exploratory workings conducted by it showed the presence of three coal seams from $^1/_2$ to 1 sagene thick and having a considerable extension. From trials made by the fleet it was found that this coal is a semi-anthracite resembling Cardiff coal in its properties. A mine was laid out there by the expedition, and it is proposed to offer the exploitation of this mine to private enterprise. Lastly a deposit of coal has been found in the gulf of St. Olga on cape Nizmen.

There are rich coal fields on the island of Saghalin. The coal became known to the Russian sailors in 1859, when they began working it in the bay between cape Zhonkier (Doue) and cape Khoindzhe. From that time the coal beds in the neighbourhood of the station of Doue have been worked uninterruptedly. Since 1875 these mines have been in the hands of a private company, who has now increased their output to a million pouds. The coal lies in a whole series of beds from two to five feet thick; it is of excellent quality and quite equals the best sorts of Welsh coal. It contains from 74 to 84 per cent of carbon, a very small amount of ash and it gives up to 60 per cent of coke. The coal is chiefly consumed by the Russian vessels navigating the shores of Siberia, but it is also used by foreign vessels coming to the Russian ports of the Pacific. A number of coal beds have been discovered to the north and south of the Doue station, but only one of these, situated between the mouths of the rivers Sertounai and Nayassi, has been worked. The quality of this coal

and its mode of occurrence are exactly similar to those of the Doue coal. Several coal deposits are also known in the interior of the island.

In the region of the Kirghiz steppes, the search for coal formed the special care of the Government for a very long time. The prospectings were carried on in the Orenburg region, adjacent to the Kirghiz steppes; and the chief inducement for this search was the entire impoverishment of the forests in this region, necessitating the abandonment of all its mineral wealth for want of fuel. The vast area of the Obschyi Syrt, which 80 or 100 years ago was covered with forest, is now transformed into a bare steppe without a single twig, and where the only fuel is dried dung. The vast Bashkir forests, which according to the general survey, comprised four million dessiatines, have been more than half felled. The search for coal in different parts of the Orenburg steppes was not however crowned with success. Prospectings conducted in the Obschyi Syrt only showed the presence of combustible schist of medium quality, belonging to the jurassic system. The deposits of brown coal discovered in the Troitsk and Cheliabinsk districts have up to now been considered unworthy of attention, but apparently other deposits have recently been discovered which might receive a practical application.

Two vast coal fields have been discovered further in the Kirghiz steppes, in its western portion in the Tourgai province. The first of these is situated at a 170 versts distance to the south-east of the town of Tourgai, formerly an Orenburg fortress, on the upper courses of the river Dzhilanchik, near Maidam Tal. Two horizontal seams of brown coal are known there. The thickness of the upper seam is from one to $3^1/_2$ feet, and the lower seam is about 1 foot thick; they are separated by seam of soft, blue clay 1 foot thick. The coal of these seams is of two kinds, one a dense bitumenous coal with a bright conchoidal fracture and the other a slate coal. This deposit has been followed up by exploratory workings for a distance of five versts in length up the river Dzhilanchik and for a width of 100 to 200 sagenes. Taking the mean thickness of the upper seam only as 2 feet and the weight of a cubic sagene of the coal as 340 pouds the explored portion of the upper seam would contain about 40 million pouds.

The second deposit of brown coal is situated at 100 versts to the east-north-east of the town of Tourgai, at the Yar-Koue wells, on the declivity of a height which forms, as it were, the mountain shore of the valley of the river Tourgai. Some ancient wells were found on the declivity of this height at 5 versts distance from the above mentioned wells, and in clearing them out, traces of coal were found in them. They were then deepened and a seam of coal about one sagene thick was encountered. This discovery was followed up by extensive exploratory workings, which embraced an area of $3^1/_4$ square versts of coal field. As the average thickness of the coal seam is one sagene, and a cubic sagene of coal was found by experiment to weigh nearly 340 pouds, the area explored contains over 275 million pouds of coal. The coal of this deposit is dark brown, has a laminar structure and a conchoidal fracture. It burns with a bright flame and gives from 4 to 7 per cent of ash; some portions contain sulphur pyrites. It has been proved by experiment that this coal is quite suitable both for ordinary heating and for steam purposes, as on the steamers of the Syr-Daria, and also for treating metals in reverberatory furnaces.

Several coal seams are known in the Akmolinsk province on the upper courses of the rivers Ishim, Sokour and others, which fall into the Noura. The Karagandinsk pit, belonging to Messrs. Riazanov, is situated at 200 versts to the north-west of Karkaralinsk near the borders of the Akmolinsk and Semipalatinsk provinces. Two coal seams are know, 1 and $2^1/_2$ sagenes thick. Both are worked, and have been shown by exploratory workings to extend on both sides to the east and west for a distance of 11 and 9 versts. Thus this deposit is very vast. The coal is a true coal with 8 to 12 per cent of ash and semi-caking coke. In former times the Spassk works, situated at 30 versts distance to the south of the pits, smelted their copper to the amount of 30,000 pouds annually, with this coal. The yield of the Karagandinsk mine has been somewhat considerable during the last 15 years, and in 1884 it exceeded 1,500,000 pouds of coal. Many coal seams are known in the Pavlodarsk, Karkaralinsk and Semipalatinsk districts, and also in the neighbourhood of the town of Sergiopole.

In the Pavlodar and Karkaralinsk districts, the Taldykoulsk mine is on the first coal bed discovered in the Kirghiz steppes, in 1838. It is situated at 25 versts to the north-east of the Alexandrovsk works and at about 200 versts from Pavlodar. Exploratory workings were carried out at the beginning of the forties which showed that the deposit extended for a length of one verst and for a width of half a verst. As many as eight coal seams were discovered from 1 to $3^1/_2$ feet thick. This coal was used in the smithies and partly in smelting the lead ores at the Alexandrovsk works. Altogether 337,000 pouds of coal were extracted from this deposit between 1838 and 1860. The Sarykoulsk coal deposit is situated at 12 versts distance to the south-west of the Taldykoulsk pits and 50 versts to the north of Bayan-Aoula. The coal here occurs in a bed 4 feet thick at a depth of 16 feet under the surface. The Maoukobensk coal mine is situated at a distance of 5 versts from the Sarykoulsk deposit and at 20 versts to the north-west of the Alexandrovsk works. The total thickness of the three worktable coal seams is 5 feet. The coal seams have been determined over an area of six square versts. The coal was found by chemical analyses to contain 50.5 per cent of carbon, 42.10 per cent of volatile matter and 1.4 per cent of ash. The coal is black, bitumenous, burns with a long flame but does not coke. It was used for copper smelting. This mine was worked during 1869 and 1870.

The Nikolsk mine is situated at a distance of 90 to a 100 versts to the north-west of the Alexandrovsk works, near lake Alka-Sor. There are two seams of anthracite 2.25 and 6 sagenes thick. They lie between clay slates and limestone. This anthracite was found by analyses to contain 74 per cent of carbon, 14 per cent of volatile matter and 12 per cent of ash. It was found by trials made at the copper smelting works, that this coal gives a very powerful heat. The Kysyltavsk mine is situated at a distance of about 70 versts from the Alexandrovsk works and 90 versts from the Bogoslovsk copper and lead smelting works. This is one of the best coal fields known. It includes five seams from 2 to 4 feet thick. The Ioanna-Predtechensk copper smelting works are erected immediately over the mine. The Kysyltavsk coal gives a fairly good coke. In 1873 this mine yielded altogether $2^1/_2$ million pouds of coal. The Dzhemantouzsk mine is also upon one of the thickest and best coal beds yet found in the Kirghiz steppes. It was discovered in 1864, at 90 versts to the south of the Alexandrovsk works. This mine comprises five coal seams from $^1/_2$ to 3 feet

thick, which unite at a depth of 13 sagenes into one bed which dips at an angle of 32° to 42°. The Dzhemantouzsk coal is an anthracite of a gray colour. It is dense and bright with a roughly conchoidal fracture and gives a great heat, but no coke. It contains a very small amount of sulphur, pyrites and gypsum. This deposit is situated at 60 versts distance from the river Irtysh. In the Semipalatinsk district coal was first discovered in 1869, by Mr. Permikin a gold mine owner, at 7 versts distance from the Grachevsk station and 120 versts from the town of Semipalatinsk.

A whole group of coal fields occurs in the north-eastern portion of the Kirghiz steppes at 18 to 20 versts distance from the left bank of the river Irtish and about 120 versts to the west of the town of Semipalatinsk. The presence of coal in the neighbourhood of the Irtysh was known at an earlier period, as in the sixties a gold mine owner, Mr. Kouznetsov, erected a copper smelting works on the left bank of the Irtish, which consumed coal from a mine situated near lake Dongoulek-Sor. This deposit contains two seams of coal, whose total thickness is about one sagene. They are separated by a layer or clay slate two feet thick. The coal from this mine is black and very bright, rather dense and gives a coke of good quality. This coal must be regarded as the best in the Kirghiz steppes. The Ouzoun-Sor deposit is situated 8 versts to the south of the above mine, and the Oinak-Sor at 6 versts distance to the south-east of the latter. The Oinak-Sor deposit includes several coal seams, from two to fifteen feet thick, but the seams are very distorted. The coal of these three and other adjacent out-cropping seams, can not only furnish the inhabitants of the steppes with fuel, but could also have an important significance for the steam navigation of the Irtish and for the Siberian Railway, as well as for the metallurgical works of the Altai and Kirghiz steppes.

Deposits of coal have been found in several places in the neighbourhood of Sergiopol over a distance of 20 versts along the river Ayagouz and its tributaries. The following four are among these deposits: 1. The Spassk mine on the left bank of the Ayagouz, above the river Baiboulak. Several thin seams of coal from $1^1/_2$ to 3 feet thick were discovered here, the thickest of them being over 4 feet. This coal is not of particularly good quality; it is black, finely laminar, disintegrates in the air into a fine powder. It is only used as smithy coal. 2. The Krestovsk mine, on the right bank of the river Ayagouz, in the upper sources of the Kyzyl-Chilik, is at two versts distance from the Spassk mine. The seam of coal, which was found at an inconsiderable depth, proved exceedingly thin and the coal was found to contain a large amount of ash. 3. The Troitsk or Chekartinsk mine lies at eight versts distance from the Spassk mine, near the river Chekarta. The coal seams are here considerably thicker than in the Spassk pit and are as much as 1 sagene thick in some places; it is of good quality and is used in smithies and for house heating. 4. The Voskresensk deposit is situated at 10 versts from the Spassk pit, on the left side of the river Ayagouz, above the river Chekarta. The inconsiderable exploratory workings made in this deposit do not give any idea of its extent or quality.

The above concise enumeration of the coal deposits of the Kirghiz steppes, show that this region, which is so in want of fuel for the exploitation of its mineral wealth in silver, lead, and copper ores, may apparently be considered as fully guaranteed in this respect. But

at the present time the production of coal has not only made no progress but has even fallen. Although the production from 1880 to 1885 equalled from one million to 1,635,000 pouds a year, it has considerably fallen in recent years, and in 1891 was only 86,800 pouds.

Graphite.

Deposits of graphite are known in Siberia in the Kirghiz steppes, and in the governments of Yeniseisk and Irkutsk. In the Kirghiz steppes several deposits have been discovered, three of which, situated in the Kokpektinsk and Sergiopolsk districts, have been exploited and the graphite sent from there to the Perm steel and gun works. In the government of Yeniseisk deposits of graphite were discovered in 1859 and 1863, by a Mr. Sidorov, in the Tourankhansk region along the rivers Nizhnaya Toungouzka, Bakhta and Koupeika, the right tributaries of the Yenisei. At a distance of 200 to 500 versts up the Nizhnaya Toungouzka there are four localities where graphite is found. This graphite is sometimes laminar and sometimes columnar, and occurs in beds from one to two sagenes thick, between layers of clay slate which have been metamorphosed by the action of eruptive rocks; so that it may be supposed that this graphite has proceeded from the beds of jurassic coal which abound in this locality. The graphite contains from 4 to 6 per cent of clay. It is estimated that this deposit contains a store of 10 million pouds of graphite. The excellent quality of this mineral has been recognized at both Russian and foreign exhibitions. The Touroukhansk mineral has met with particular praise from various scientific and practical men; several foreign authorities have likened it to Cumberland graphite, and in America a series of comparative experiments proved that it excels the Ceylon graphite in purity. In 1877 an other deposit of graphite was discovered by Sidorov on the Nizhnaya Toungouzka, and 2,000 pouds of picked graphite were extracted and sent abroad. Seventy thousand pouds of graphite have been extracted from the deposits discovered by Sidorov in 1861, along the river Koureika, which falls into the Yenisei at a 100 versts from the town of Touroukhansk. Out of this amount the following parcels were dispatched during the winter 1863 to 1864: 1. five hundred pouds direct along the river Pechora, over the northern marshes by reindeer and thence by sea to London; 2. five thousand pouds also by the northern route to the river Taz by reindeer and thence by the Taz and Obi Bay to Obdorsk, and then by the Pechora; 3. seven thousand pouds by Yeniseisk, Tomsk and Tumen to Perm, and one thousand pouds by the same route to St. Petersburg; 4. two hundred pouds from St. Petersburg to Hamburg and Wurzburg. In 1891, ten thousand pouds of graphite were extracted from the deposit on the river Nizhnaya Toungouzka for the recently formed Siberian Graphite Company.

In the government of Irkutsk a deposit of graphite was discovered in 1842 by Mr. Aliber in Boutogolsk Golts in the Tounkinsk mountains on the spot where the rivers Irkout, Kitoi, Belaya and Oka take their source. Here the graphite apparently occurs in reniform masses, in druses and in veins in alternate beds of crystalline limestone and laminar granite with quartz veins. In 1856 Aliber laid out the Mariinsk graphite mine on

this spot and obtained a graphite of excellent quality, and samples exhibited at the London Exhibition of 1862 proved it to be in many respects better than the English. Aliber entered into relations with the well known pencil maker Faber and began to supply him with considerable amounts of graphite. At the present day however this mine is only worked to supply graphite for making crucibles at the Irkutsk gold melting house.

Naphtha.

The occurrence of naphtha has long been known on the northern extremity of the island of Saghalin, and it has now also been found near the gulf of Nabilsk, which is accessible to the largest ocean vessels. According to the researches of Mr. A. Batsevich, mining engineer, the naphtha deposits of this island extend in a meridional direction, towards the Sea of Okhotsk, where they occur at a distance of 5 to 25 versts from the shore. The specific gravity of the naphtha extracted from wells up to 3 sagenes deep over various areas, varies from 0.890 to 0.895, and the daily yield is several pouds. Judging from the specific gravity and the results obtained by distillation, the Saghalin naphtha resembles the Caucasian. The occurrence of naphtha springs over a considerable area, and their abundance, combined with the thickness of the superficial and subterranean deposits of bitumen (asphalt of recent formation) and the daily flow of naphtha in the wells, made Batsevich conclude that there must be more or less considerable stores of naphtha at a certain depth below the surface.

Salt.

In Western Siberia salt is exclusively extracted from the self-depositing lakes, which occur in considerable numbers in the southern portion of the region, namely in the southern regions of the government of Tobolsk, in the south-western portion of the government of Tomsk, and in the Akmolinsk and Semipalatinsk provinces. This area, which is included between 47° and 55° north latitude and 63° and 73° eastern longitude (from Paris) is a low lying plane, which was once the bottom of a sea basin. In the northern portion of this salt basin, which embraces the Barabinsk and Kouloundinsk steppes, the salt lakes always contain a more or less considerable amount of other salts than common salt, the chief being sulphate of sodium. There is no lake in the region of these steppes, which gives pure chloride of sodium, and on the contrary, there are many which contain rich layers of glauber salt only. But in the southern and south-western portion of this salt basin which embraces the arid steppes of the Akmolinsk and Semipalatinsk provinces the deposited salt is in the majority of cases distinguished for purity of its chloride of sodium, and these lakes are the chief sources of its production.

The salt lakes of Western Siberia may be divided into four groups according to their characteristics: 1. The lakes which contain more or less considerable beds of chloride of

sodium covered with a brine which deposits fresh layers of salt every year. Compared with the others these lakes are the richest and are the most important by reason of the vast stores of salt they contain. Among the many lakes of this category belonging to the State the chief is the Karyakovsk lake in the province of Semipalatinsk at 20 versts from the town of Pavlodar and 28 versts from the Chernoyarsk landing stage on the river Irtysh. In this lake, which covers an area of about 20 square versts, the surface is covered by layers of salt for a space of about 9 square versts, and the thickness of these deposits reaches to as much as half a sagene. The annual yield of salt from this lake amounts to one million pouds. The salt from the Koryakovsk lake is distinguished for its high quality and is considered the best in Siberia. 2. The second category iucludes those lakes which contain considerable amounts of strong brine, which annually deposit a layer of pure chloride of sodium, varying from 1 to 4 inches in thickness. Although these lakes, compared with the preceding, have only a secondary importance, nevertheless they are capable of yielding immense quantities of salt. To this category belong the lakes exploited in the government of Tomsk, the most important of which are the Borovya and Bourlinsk lakes.

The Borovya lakes include four lakes: 1. the Pechatochnoe or Maloe Lomovoe; 2. the Kochkovatoe; 3. the Bolshoe Lomovoe; 4. the Malinovoe lakes. They are situated on what is called the Salt steppes. In recent years these lakes have yielded up to 600,000 pouds of salt. The Bourlinsk lake is one of most important sources of salt in Western Siberia. It resembles the Borovya lakes in the mode of occurrence of its salt and is only distinguished for its size, it being over 30 versts in circumferance. The Bourlinsk lake belongs to the number of those which dry up periodically. There are many such lakes in Siberia. It has a great industrial importance, owing to its situation in proximity with the chief trading routes of the steppes, by which the peasants of the grain bearing regions of the government of Tomsk carry their grain to Pavlodar for sale to the Kirghiz. The salt from the Bourlinsk lake forms a return freight for these peasants who transport it to a further distance. Besides which, this salt is transported along the river Obi to Tomsk and further to Achinsk and to Eastern Siberia. The annual yield of the Bourlinsk lake is about 1¹/₄ million pouds. 3. The lakes of the third group are full of brine containing a greater or less amount of other salts, than chloride of sodium. They form a link towards bitter salt lakes. Owing to the comparatively little strength of the brine, the lakes of this category do not as a rule give a deposit every year but only under suitable atmospheric conditions, and the salt then obtained is naturally of a poor quality. These lakes, which are numerous and of large dimensions, now scarcely have any importance as a source of national provision. They could only give a pure salt, fit for consumption, if they were exploited by the artificial basin system, which owing to the number of excellent self-depositing lakes cannot as yet thrive in Siberia. To this category belong many lakes in the government of Tomsk, and all those situated in the Barabinsk steppe besides a considerable number of the Kirghiz lakes. 4. Lastly the fourth group comprises the bitter salt lakes, containing considerable layers of glauber salt which are constantly increasing in thickness owing to the annual deposition of fresh layers from the brine. The Bolshoe Marmyshansk lake is a representative of this category, and is the only one of this class now under exploitation. It yields about 100,000 pouds of salt a year. The Bolshoe and Maloe Marmyshansk lakes are situated in the Kouloundinsk

steppe at 200 versts distance to the south-west of Barnaoul, along the road to the Borovya lakes, and present immense deposits of glauber salt, whose thickness at a distance of 60 to 100 sagenes from the shore is already two feet. Taking into account that the surface of the Bolshoe Marmyshansk lake is over 4 and of the Maloe over 2 square versts, the most moderate estimate gives a supply of not less than 50 million pouds in the former and 25 million pouds in the latter lake. The Marmyshansk salt is partly consumed at the soda works at Barnaoul, partly at the Altai works, which use it as a flux in smelting the argentiferous lead ores, and partly at the glass works.

Eastern Siberia abounds in salt, but the richest deposits of rock salt and the best salt springs, are situated in poorly inhabited localities, so that its transport to the markets owing to the want of proper means of communication is hampered by great difficulties which render it very expensive. Therefore many of the sources are not exploited and await the time when the economical conditions of the region will give the possibility of working them.

In the Yeniseisk and Irkutsk governments, salt is extracted from saline springs. In the government of Yeniseisk, at the Toumanshetsk works in the Kansk district and in the system of the river Birusa, the depth of the well is $2^1/_2$ sagenes, the strength of the brine $4^1/_2{}^0$ Baumé, and in 1891, 17,500 pouds of salt were produced; at the Troitsk works in the same district, on the river Ousolka, a left tributary of the river Taseev, the production of salt in 1891 amounted to 514,000 pouds. Both deposits belong to the Devonian system and the brine flows from red salt-bearing marls and slags. In former days when the amount of salt mines and works in the Yeniseisk and Minousinsk regions was very limited, the Troitsk works played an important part in supplying the local inhabitants with salt.

In the government of Irkutsk there is an abundance of salt springs in the valley of the river Lena, between the stations of Kachougsk and Vitimsk; and also in the valley of the river Nepa, a left hand tributary of the Nizhnaya Toungouzka, where brine springs from reddish coloured sandstone, marl and clay formations, apparently of the Lower Devonian system. The exploitation of the salt is carried on at the Oust-Koutsk salt works, on the river Kouta at 4 versts distance from the Lena. The depth of the well is 3 sagenes and the strength of the brine 14—15^0 Lamb; in 1891, 30,100 pouds of salt were produced. The Oustkoutsk works might considerably increase their yield but the market is very small, being limited to the sparsely populated localities of the Yakutsk province and to the Olekminsk gold workings. Apparently the same Devonian formations supply the brine which feeds the Irkutsk works in the village of Ousola at 70 versts distance from Irkutsk, down the Angara. The depth of the wells are 2—5 sagenes; and of the borings, 89 sagenes. The strength of the brine is 6—7^0 Baumé, and in the wells it is $7^1/_2$—$9^1/_2$ Lamb. In 1891 the production of salt was 265,500 pouds. The salt produced at the Irkutsk works is sold at the Irkutsk government and Transbaikal territory, where it is in demand for salting the local fish omul with which the rivers falling into Baikal abound. At the Ilimsk works, near the settlement of Shestakovsk on the river Ilim, the right tributary of the Angara, the depth of the shafts is one to one and a half sagenes, the strength of the brine 8.73^0 Lamb. In 1891, 85,100 pouds of salt were evaporated.

The salt deposits, representing the transition to lacustrine deposit, where the brine is extracted from excavations or wells dug in the bottom of salt lakes, occur in the Yeniseisk government, at the following works: 1. Abakansk in the Minousinsk district, 25 versts from the Bidzha ulus, the depth of the wells upon the bottom of the lake is 9 feet, the strength of the brine 9—13° Bome; 2. Altaisk, on the left bank of the Yenisei between the rivers Erba and white Ius, now abandoned, the lake having concentrated too much bitter salts; 3. Manzinsk, depth of wells 12 feet, strength of brine 5° Bome. The total production of these mines in 1891 did not exceed 93,800 pouds.

Besides the lakes mentioned, in which the cooperation of common salt is now established, the Yeniseisk government also contains a number of lakes with bitter salts, among which that of Minusinsk from its extent, $2^1/_4$ square versts, and the quantity of salt contained in it belongs to the most considerable bitter lakes of Eastern Siberia. Formerly, up to 1877, salt was deposited by natural evaporation in the Minousinsk lake, although with a certain intermission, and with it almost the whole region of that name was supplied, there being then no salt works.

In the Yakutsk borderland, rock salt occurs in three spots of the Viluisk district of the Yakutsk territory, along the right tributaries of the river Vilui. On the right bank of the river Kempendzai the deposit of rock salt forms a bed about 150 sagenes in length and 50 in thickness. The salt is contained in red clay and is everywhere accompanied by plaster of Paris partly in crystals, partly in plates of white or greenish hue. In some places the projecting rocks of salt attain a height of 25 sagenes; it is ordinarily white, although pieces of a rose colour occur. On the right bank of the river Kiundai not far from the lake Sikai-Sian, rock salt forms two masses in a mountain also consisting of red clay and gypsum. Finally, upon the right bank of the small stream Tabasyngda, a tributary of the river Tongo, also in red clay, at a depth of $3^1/_2$ feet, lies rock salt of a dirty colour. During the spring inundations this salt is washed out of the banks in such quantities that the water in the stream acquires a brackish taste, as in the river Kempendzai. All three deposits apparently belong to the tertiary system. In the Viluisk district of the Yakutsk territory, salt is obtained in winter by freezing the brine got from the salt springs of Baginsk on the river Pusty Iri, a left tributary of the Kempendzai, and Kempendzaisk on the river of that name a right tributary of the river Vilui. The strength of the brine reaches 20 to 25 per cent. The springs flow from a mountain probably containing beds of rock salt of tertiary age, judging from the propinquity of the above described deposits of the mineral. In 1891, 2,800 pouds of salt were won from the Baginsk spring and 16,000 from the Kempendzaisk.

In the Amour Governor-Generalship, salt is evaporated in the Transbaikal territory at the works of Selenginsk in the district of that name, and Kiransk in the Troitskosavsk district on the frontier of Mongolia. There the brine is derived from shafts, 2 to 3 sagenes deep, dug in the bottom of salt lakes. The strength of the brine is 11 to 12° Bome. In 1891, 4,100 pouds of salt were got at the Selenginsk works and 23,300 pouds at those of Kiransk. In the Transbaikal territory occurs also lake Borzinsk where natural deposits of salt take place although not every year; in 1891, 19,800 pouds were extracted. Here must also be mentioned the Doroninsk lakes of the Bargouzinsk district of the Transbaikal territory, in which Glauber's

salt is obtained for the glass works. In 1891, 20,000 pouds of it were obtained. Formerly, glauber's salt was also extracted from the Torzhiransk lake in the Baikal mountains, near the Olkhonsk steppe d u m a, or seat of the local Tunguz administration.

The total yield of salt in Siberia both by natural evaporation and from salt works does not exceed, even under the best circumstances, two to three million pouds per annum, a quantity which it is obvious cannot meet the wants of the whole population of Siberia possessing as it does a considerable quantity of cattle.

The production of salt for the last ten years from the different governments was as follows.

Year.	Tomsk.	Yeniseisk.	Irkutsk.	Transbaikal.	Yakutsk.	Semipalatinsk.	Total.
1881	1,073,225	159,660	393,351	4,359	8,064	—	1,638,659
1882	599,913	181,168	469,689	8,797	8,000	1,169,510	2,437,077
1883	600,000	177,753	460,519	22,341	—	400,000	1,660,613
1884	743,989	147,504	577,098	29,021	18,000	474,840	1,991,452
1885	1,162,507	201,596	468,210	34,025	—	397,108	2,263,446
1886	278,122	194,640	450,556	7,599	—	353,415	1,284,332
1887	1,001,469	185,840	375,524	—	—	470,897	2,033,730
1888	1,756,247	110,909	369,886	23,013	6,500	437,926	2,704,481
1889	678,496	152,927	359,805	43,829	9,000	914,093	2,158,150
1890	1,848,355	232,178	376,567	39,823	17,300	1,099,577	3,613,800
1891	512,692	194,966	380,721	47,244	18,800	598,664	1,753,087

From the enumeration of the territories in which salt is obtained, it is evident that immense areas of Siberia are almost destitute of their own salt and consequently must be satisfied with the imported article. Such for example are Semirechensk, Akmolinsk, the Littoral, Amour and other territories. Some of these regions possessing more or less convenient communications easily get over this difficulty, but others are frequently placed in an extremely embarrassing situation. For the avoidance of such a state of things the Government has long since recognized the necessity of taking upon itself the care of furnishing the population with salt, mainly that of Eastern Siberia and Amouria, as least favourably situated in reference to the supply of the mineral. With this view the Government has, in various places of the territory mentioned, depots of salt and stores in which the necessary supplies are always ready and given out at a very moderate price. Supplies collected by the Government authorities are then distributed in different directions as required. Independently of this and with the same view of better providing the people with salt, the Government recognized the possibility of allowing the Kirghiz of the Ural, Turgai, Akmolinsk and Semipalatinsk territories the free use of salt from the Crown lakes of the Kirghiz steppe. Moreover to the Siberian Cossack levies are issued 5,000 pouds of salt per annum from the Crown, free from any payment. This is taken straight from the Borovy lakes, the cost of carriage of the salt from these lakes to Semipalatinsk and Ust-Kamenogorsk being covered by a grant

from the Crown of 1,000 roubles per annum. Foreign salt is imported duty free into the Siberian ports of the Eastern Ocean. The total expenditure of the Crown upon this operation amounts annually to about 100,000 roubles.

Precious minerals and building materials.

The best known place in all Siberia where precious minerals are found is the Transbaikal territory. Here between the rivers Onon and Onon-Borza rises the granitic mountain Adun-Chilon, celebrated for the frequent discovery there of precious coloured stones, such as topaz, beryl, aquamarine, Siberian topaz and others. On the Onon, eighty-five versts from Nerchinsk are found garnets in small crystals.

Lapis lazuli occurs in the Baikal mountains along the rivers Talaya and Sliudianka, flowing into Baikal, and along the stream Malaya Bystraya, a tributary, of the Irkut. In the last locality lapis lazuli of good quality forms pockets in the large crystalled dolomitic limestone, near its junction with the syenitic granite. In the sixties pieces of lapis were worked here three pouds in weight. From these deposits was obtained the lapis lazuli which served for the veneering of the columns in the St. Isaac Cathedral in St.-Petersburg, and for the execution of a mass of artistic productions placed in the Imperial palaces. In the same locality where occur the deposits of lapis lazuli, dark red garnets are met with in crystals attaining two inches in diameter, along the Bolshaya Bystraya amazon stone, sphene and feldspar of a crimson colour are found; along the Talaya, mica, serpentine, talc and other minerals; along the Sliudianka, blue calcareous spar, white marble, rose coloured quartz, garnet, asphanite and others; in the valley of the Uluntui, black mica in plates two feet in diameter. This kind of mica was formerly worked here.

Pebbles of nephrite are found along the river Bielaya falling into the Angara fifty versts below Irkutsk, and along the Iret and Onon, tributaries of the Bielaya. Here pebbles of this mineral used to be found weighing as much as 30 pouds.

The Altai mountains on the other hand, have become celebrated for their porphyry and jasper of various colours, forwarded from the Korgon ridge, from the banks of the Charysh and Alei and from the vicinity of the Ridder mine to the Kolyvan polishing works, whence manufactured articles are despatched over four thousand versts to the Imperial Court at St. Petersburg. At these works a mass of remarkable works of art have been turned out, which now embellish many of the Imperial palaces. Among them is the jasper vase placed in the Imperial Hermitage in St. Petersburg, the oval cup of which has a long diameter of twenty feet. At the present time not less than eight quarries are being worked in the Altai, producing porphyry, blue and green jasper, granite, white and coloured marbles breccia, smoky topaz, red, rose-coloured and blue quartz, agate and chalcedony.

Besides lime, building stone of various kinds, mill stones and common clays, got in many parts of Siberia, it should be mentioned that in the neighbourhood of the Nicholas cast-iron

works in the Irkutsk government, and also for the needs of several works in the Kirghiz steppes, fire-clay and fire-resisting sandstone are worked. The former is also obtained in the Yeniseisk government near the village of Kantat in the Krasnoyarsk district, near the village of Parilovaya in the Achinsk district, as also in the Irkutsk government along the river Bielaya. Kaolin and white clay for the porcelain works are worked in the Irkutsk government in several places. Feldspar and quartz for glass factories are obtained from several deposits in the Baikal mountains of the Irkutsk government.

CHAPTER XII.

Manufacturing industry and the home trade.

Excisable industries, spirit, vodka, beer and mead; beet sugar, tobacco and matches; non-excisable productions; distribution of trade dues and statement of the turnover and profits of commercial and industrial undertakings; the exchange of wares between European Russia and Siberia; trade in the towns; fairs and their importance to Siberia.

NOTWITHSTANDING the wealth of Siberia in the productions of the three natural kingdoms, manufacturing industry has not been able here to develop itself to a corresponding extent on the one hand, in consequence of the scanty population of this vast territory, and on the other, on account of the lack of convenient and cheap communications. In view of this, in spite of the repeated attempts of the Government and of private persons to establish industry on a large scale in Siberia, manufactories and works have been started there only with great difficulty, and only those of them have had success which served to satisfy the local wants of a small population, or produced an article of such value that it might bear the cost of carriage to a great distance with profit.

The state of spirit distilling in Siberia appears from the following table.

	Nnmber of distilleries.	Amount distilled from:		Absolute alcohol, degrees in vedros.	
		Grain.	Potatoes.		
		P o u	d s.	1891.	1892.
Eastern Siberia	19	1,213,562	—	50,278,500	52,729,200
Western »	21	1,408,908	55,391	58,866,300	58,770,000
Littoral and Amour territory	1	33,439	—	1,335,700	1,599,000

Spirit in Eastern Siberia is mainly distilled from rye and wheat flour, a poud of the dry material yielding on an average 41·12 degrees of spirit. This industry is concentrated for the most part in the Irkutsk government, where in 1891, 20,800,000 degrees were produced, next in the Yeniseisk with 15,300,000 degrees, and in Transbaikalia, 14,200,000 degrees. In the Yakutsk territory distilling is entirely absent.

Of 21 distilleries in Western Siberia 9 are in the Tobolsk government, 11 in that of Tomsk and 1 in the territory of Semipalatinsk. Here as in Eastern Siberia the material used for distilling are rye and wheat flour as well as potatoes whose introduction has led to excellent results. On the whole a poud of raw material yields 41·44 degrees of spirit. Assuming the population of Western Siberia and the Kirghiz steppes in accordance with the above quoted data at approximately four and a half million souls, it results that the consumption of spirit per head in this part of Siberia does not exceed 13 degrees per annum or one-third vedro of vodka, 40° proof. It is evident that the population of Siberia cannot be satisfied with such an insignificant quantity of spirit, and accordingly this defect is made good by the importation of spirit from the eastern governments of European Russia. In Eastern Siberia the consumption per head of spirit is approximately the same as in Western Siberia the deficiency being here supplied by importation from Odessa by sea. Yet if due account be taken o the isolation of many points of the Yakutsk and Littoral territories whither spirit penetrates only in rare cases, it is impossible not to allow that the consumption of spirit here per head must be distributed extremely unevenly, the greater part of the vodka being consumed by the town population.

The vodka industry in Siberia is very feebly developed and is almost confined to the production of refined spirit, the manufacture of various vodkas or liquors occupying a secondary place. In the 22 vodka distilleries in 1891 for the whole of Siberia only 41,370 vedros of various liquors were made.

Beer and mead brewing are also but feebly developed in Siberia. In 1891, 51 breweries in all were going, among which 19 also produced mead. These breweries were distributed as follows: in Eastern Siberia, 13; in Western Siberia, 24; and in the Littoral and Amour territories, 14. The total brew in them was as follows:

Irkutsk	3	breweries	26,600 vedros beer; 1040, mead.
Yeniseisk	6	»	27,000 » »
Transbaikal	4	»	8,500 » »
Tobolsk	5	»	200,000 vedros beer; 41,100, mead.
Tomsk	12	»	
Semipalatinsk	2	»	
Akmolinsk	6	»	

Thus, the local production of drinks subject to excise cannot satisfy the existing demand for them, and accordingly they, like spirit and vodkas, are imported from various parts of the Empire by land or by way of Odessa and Vladivostock.

The excise from various liquors amounted in 1891 to 10,841,960 roubles, of which Eastern Siberia produced 4,654,206 roubles worth, and Western Siberia 4,302,668 roubles, the Littoral and Amour territories 680,090 roubles, and the territories of Akmolinsk, Semipalatinsk, and Semirechensk, 1,204,996 roubles worth.

Tobacco culture, although universally introduced wherever climatic conditions permit, possesses no commercial importance, serving only for the satisfaction of the unexacting

taste of local consumers. Only the inferior sorts of tobacco are grown in kitchen gardens together with vegetables. During the last few years the crop of makhorka, bakun and similar qualities was as follows:

	1886	1887	1888	1889	1890	1891	
Eastern Siberia .	26,308	31,510	28,736	26,713	28,410	32,758	pouds.
Western Siberia .	33,967	33,895	33,121	37,902	35,498	40,872	»
Total . .	60,275	65,405	61,857	64,615	63,908	73,630	pouds.

In all Siberia there is but one tobacco manufactory with a section for makhorka, in which, in 1891, 3,400 pouds of tobacco were manufactured and banderoles issued to the amount of 44,592 roubles. The considerable demand for tobacco goods is supplied by the import of the latter from other parts of the Empire.

The sugar industry is a perfectly new enterprise in Siberia. It could never arise here independently, and accordingly the Government recognized the utility of offering the pioneers in this industry in Siberia certain privileges, as was also done in Turkestan and the Caucasus. With this object the following order was promulgated on the first of May, 1884. 1. Of the beet-sugar bakeries which shall be founded in Turkestan, in Siberia, or in Transcaucasus and shall begin operations before the 1st August, 1889, the first three such in each region enjoy in the course of nine consecutive sugar-baking seasons, privileges in the payment of excise. These privileges are offered to each of the said bakeries from the date of its opening upon the following bases: a. during the first four seasons the sugar bakery is freed altogether from the payment of excise on the whole of the sugar made in it; b. during the three following periods the existing excise is exacted to the extent of one-fifth; c. in the course of the two last privileged periods the excise is collected in the proportion of one-half. 2. In the course of the seasons of sugar baking, 1884 to 1885 and 1886 to 1887, authorization is given to extract sugar, syrup and molasses from sorghum and other sacchariferous plants besides, but without the payment of excise and license dues. The said manufacture may be conducted both in private sugar bakeries specially arranged for the purpose and in beet-sugar manufactories observing the rules established by the Ministry of Finance.

Thanks to this measure in 1890 the first beetsugar bakery was opened in the Minousinsk district of the Yeniseisk government. In 1890 only 8,450 pouds of beet were treated, but in 1891, 92,000 pouds from which 5,850 pouds of white sugar were obtained. The experience of two years completely convinced the initiators that the conditions of soil and climate of the Minousinsk district were perfectly adapted to the cultivation of the sugar beet, and accordingly the extension of the undertaking appears to be extremely advantageous.

Match manufacture is little developed in Siberia. There are here but 8 manufactories, 2 in Eastern Siberia and 6 in Western. The output in 1891 was:

Eastern Siberia, with phosphorus: 230,287,500 matches; without phosphorus 82,336,500 matches.
Western Siberia » » 3,614,159,250 » » » 37,383,750 »

Of the 6 manufactories of Western Siberia 2 are in Tobolsk, 3 in Tomsk and 1 in the Bisk district, and of the 2 manufactories in Eastern Siberia, one is in Irkutsk and the

other in the village of Ousolie. The first prepares exclusively Swedish matches, the second only simple lucifers. All the Siberian match manufactories get their phosphorus from Toupitsyn's works in Perm, the other raw materials being of local origin.

In all the industries named, about 3,000 workmen are employed annually, namely, in distilleries, 1,936; yeast manufactories, 14; vodka distilleries, 120; beer and mead breweries 254; the sugar bakery, 78; the tobacco manufactory, 78, and match manufactories, 330.

The total receipts of the treasury from all taxes on excisable industries, including therein excise, licenses and fines reaches 11,177,423 roubles, distributed according to different localities and manufactures in the following manner.

	Spirits.	Sugar.	Tobacco.	Petroleum.	Matches.	Total.
Eastern Siberia	4,654,206	95	93,644	—	14,700	4,762,645
Western » . . . ,	4,302,668	—	42,504	—	121,860	4,467,032
Littoral and Amouria. .	680,090	—	12,398	9,930	29,088	731,506
Akmolinsk, Semiretchensk, Semipalatinsk	1,204,996	—	11,150	—	94	1,216,240
Total . . .	10,841,960	95	159,696	9,930	165,742	11,177,423

It is evident that this sum is too small for such an immense territory as Siberia, and there can be no doubt but that as a consequence of the considerable improvements in the communications, latterly, either carried out or projected, the manufactures above named, as ministering to the daily needs of the population, must assume more extensive dimensions.

The following are the industries not subject to the payment of excise, the returns being those for 1890:

INDUSTRIES.	Western original Siberia.		Eastern original Siberia.		Amour-Littoral borderland.		Kirghiz steppe borderland.		Total.	
	Number of manufactories and works.	Value of productions, thousands of roubles.	Number of manufactories and works.	Value of productions, thousands of roubles.	Number of manufactories and works.	Value of productions, thousands of roubles.	Number of manufactories and works.	Value of productions, thousands of roubles.	Number of manufactories and works.	Value of productions, thousands of roubles.
Hides, sheepskins, and leather goods	201	1,186	38	350	17	106	55	405	310	2,047
Metals	5	187	5	338	2	46	—	—	12	571
Milling	188	2,152	13	284	33	834	150	1,005	384	4,275
Tallow and soap boiling. . . .	41	330	4	29	3	31	56	380	104	781
Timber sawing. .	—	—	3	27	—	—	—	—	3	27

INDUSTRIES.	Western original Siberia.		Eastern original Siberia.		Amour-Littoral borderland.		Kirghiz-steppe borderland.		Total.	
	Number of manufactories and works.	Value of productions, thousands of roubles.	Number of manufactories and works.	Value of productions, thousands of roubles.	Number of manufactories and works.	Value of productions, thousands of roubles.	Number of manufactories and works.	Value of productions, thousands of roubles.	Number of manufacturies and works.	Value of productions, thousands of roubles.
Candles (tallow and wax)	11	56	5	52	3	28	2	9	21	145
Brick and lime burning . . .	12	19	16	41	2	3	5	6	35	69
Porcelain, faïence and glass. .	3	65	7	280	2	18	—	—	12	363
Cloth, wool washing and felt . . .	13	218	1	57	—	—	1	40	15	315
Saltworks and salt grinding . . .	—	—	10	330	2	20	—	—	12	350
Confectionery, molasses and preserves	7	42	2	14	—	—	3	34	12	90
Chemical, vinegar	1	44	1	6	—	—	—	—	2	50
Ropewalks . . .	—	—	5	6	—	—	—	—	5	6
Writing paper. .	1	236	—	—	—	—	—	—	1	236
Oil mills and cheese making . . .	30	52	—	—	—	—	5	9	35	61
Total. .	513	4,598	109	1,824	64	1,083	278	1,888	963	9,393
Small works, not included in above, with production less than 1,000 roubles. . . .	771		56		24		577		1,428	

From this table it appears that the total production of the Siberian manufactories and works does not reach 9,500,000 roubles, and that the first place among the manufacturing industries belongs to milling, 45 per cent; the second, to the leather and sheepskin trade, afte which follow tallow and soap boiling, metals, et cetera. These industries are very unevenly distributed over the different regions. Western Siberia is alone distinguished by a great variety of productions, whose output amounts to 4,600,000 roubles. The opposite position is occupied by the Amour-Littoral borderland, whose production is about one million roubles. On the whole the manufacturing industry of Siberia is at present in an embryonic condition. Different industries arise and develop merely for the satisfaction of local requirements, in consequence of which the business of industrial and commercial undertakings of Siberia are extremely limited.

All the trade dues of Siberia scarcely amount to one million roubles, which includes the receipts on first and second guild certificates, retail trade and other licenses, market carrier dues, additional taxes to the services connected with lodgings, and the supplementary dues, three per cent on share undertakings and assessed tax on guild and non-guild concerns.

The incidence of these taxes according to different articles and governments in 1889 is shown in the following table.

Taxes:	Amour territory.	Littoral territory.	Yeniseisk gov.	Transbaikal territory.	Irkutsk gov.	Tobolsk gov.	Tomsk gov.	Semipalatinsk territory.	Semirechensk territory.
First guild . . .	8,445	6,435	8,428	22,915	23,750	20,290	11,257	1,665	1,005
Second » . . .	9,479	20,631	46,368	50,338	52,872	50,425	82,646	17,780	22,068
Retail trade . . .	2,084	2,908	17,988	6,728	17,114	39,829	25,392	3,118	10,680
Trade certificates	437	209	1,036	813	553	3,125	2,159	577	617
Clerk »	5,460	9,231	17,761	21,954	24,435	25,546	34,532	7,994	11,378
Carrier »	464	1,720	2,792	2,280	1,456	5,224	8,568	2,384	2,808
Peddlar »	102	183	390	342	195	822	2,955	372	294
Fair dues	—	—	435	1,492	705	5,524	3,557	4,200	28
Fines	424	988	5,017	1,675	2,119	5,520	4,270	543	2,214
Special taxes . .	—	—	7,810	13,009	10,205	18,158	14,032	3,190	3
Supplementary dues:									
Three per cent .	201	—	316	119	—	1,317	316	—	—
Assessed taxes .	—*	—*	9,118	—*	22,298	23,502	29,059	—*	—*
	28,721	44,772	119,675	125,698	156,927	198,688	222,327	43,343	53,633

As the assessed tax is only imposed in the four most important governments of Siberia, data on business done and profits received are only to be had for these governments, and, even so, only in respect to guild, industrial and commercial undertakings.

In the two following tables is set forth the distribution of guild undertakings according to the nature of the industry or trade in the said four governments of Siberia, with a statement of the turnover, profit and average lucrativeness for each separately for 1889

* Not collected.

INDUSTRIAL UNDERTAKINGS.	Irkutsk and Yeniseisk.			Tomsk and Tobolsk.			The four governments.			
	Number.	Yearly turnover.	Yearly profit.	Number.	Yearly turnover.	Yearly profit.	Number.	Yearly turnover.	Yearly profit.	Average profit per cent.
		Thousands of roubles.			Thousands of roubles.			Thousands of roubles.		
Hemp manufactures, mats	—	—	—	1	15	0.75	1	15	0.75	5
Woollen »	1	20	1.6	4	185.4	8.81	5	205.4	10.41	5.07
Cotton	—	—	—	1	5	0.5	1	5	0.5	10
Chemicals and cosmetics	—	—	—	4	68	3.2	4	68	3.2	4.71
Tallow, wax	—	—	—	33	497.1	38.03	33	497.1	38.03	7.65
Leather, etc.	4	135	11.6	49	1,150.3	94.63	53	1,285.3	106.23	8.26
Glass, porcelain, pottery	4	160	11.9	6	133	12.58	10	285.8	24.48	8.56
Metals, machinery	—	—	—	8	248	15.15	8	248	15.15	6.11
Flour mills	3	70	5.95	32	836.2	60.45	35	906.2	66.4	7.33
Foodstuffs	4	120	10.9	19	111.9	10.15	23	231.9	21.05	9.08
Liquors	8	691.5	53.01	11	170	10.5	19	861.5	63.51	7.37
Printing, lithography	7	39	5.3	10	36.3	5.98	17	75.3	11.28	14.98
Photography	4	13.5	1.42	7	14.6	1.8	11	28.1	3.22	11.46
Clothes	—	—	—	5	32	1.5	5	32	1.5	4.7
Bakeries, confectioners, shops	—	—	—	3	27	1.4	3	27	1.4	5.18
Various	1	51.2	5.12	—	—	—	1	51.2	5.12	10
Total	36	1,300.2	105.8	193	3,539.8	265.43	229	4,822.8	372.23	7.72

TRADING UNDERTAKINGS.	Irkutsk and Yeniseisk.			Tomsk and Tobolsk.			The four governments.			
	Number.	Yearly turnover.	Yearly profit.	Number.	Yearly turnover.	Yearly profit.	Number.	Yearly turnover.	Yearly profit.	Average profit.
		Thousands roubles.			Thousands roubles.			Thousands roubles.		Per cent.
Woollens cottons, haberdashery, and sundries	883	13,752.5	1,036.1	970	8,451.1	585.85	1,853	22,203.7	1,621.93	7.3
Ready made clothes, linen	11	422	30.52	14	376	27.55	25	798	58.07	7.28
Grocery, colonial wares	58	3,079.5	233.46	350	6,168.9	366.51	408	9,248.4	599.97	6.49
Meat, greens, fowls	19	108.5	8.87	150	1,170.8	102.56	169	1,279.3	111.43	8.71
Grain and flour	37	676.7	65.23	103	1,905.3	123.63	140	2,582	188.86	7.31
Flax, hemp, ropes	—	—	—	8	544	23.4	8	544	23.4	4.3
Metals, tools, machinery	25	957	71.55	62	985	56.15	87	1,942.5	127.7	6.57
Mechanical, optical and surgical appliances	1	25	1.25	2	65	3	3	90	4.25	4.72
Gold, silver, bronze articles	7	345	26.93	4	67	3.06	11	412	31.99	7.59
Porcelain, faïence, glass	9	255	11.44	10	99.5	7.15	19	354.5	18.59	5.24
Furniture, carpentry	—	—	—	1	35	1.75	1	35	1.75	5
Timber, wood fuel	3	55	4.6	12	90	8.6	15	145	13.2	9.1
Paper, cardboard, wallpaper	1	20	1.6	1	60	3	2	80	4.6	5.75
Leather, harness, shoes, boots	9	577.5	41.5	63	1,392.9	108.2	72	1,970.4	149.7	7.59
Soap, illuminants, matches	3	32	1.74	8	210	8	11	242	9.74	4.02
Chemicals, dry good, drugs	12	154.9	16.24	19	140.4	21.1	31	2,295.3	37.34	12.64
Hotels, restaurants, drinkshops	535	1,477.6	141.23	715	1,508.6	142.1	1,250	2,986.8	283.33	9.49
Spirit and beer stores	216	3,626.3	342.57	345	2,991.1	254.88	561	6,617.4	597.45	9.03
Tobacco shops	3	100	7	2	55	2.95	5	155	9.95	6.41
Offices, agencies	7	280	32.21	35	4,710	367.8	42	4,990	400.01	8.02
Contracts	10	310	20.35	9	221.1	12.3	19	531.1	32.65	6.15
Carriers	37	2,403.8	195.27	17	402	32.9	54	2,805.8	228.17	8.13
Various	41	1,456.8	98.06	5	20	0.95	46	1,476.8	99.01	6.7
Total	1,927	30,115.1	2,387.70	2,905	31,679.7	2,265.37	4,832	61,785	4,653.09	7.53

The above table shows at a glance what goods form the subject of home trade. In the forefront appear woollen and cotton goods swallowing up 36 per cent of the annual turnover; next follow groceries 15 per cent, liquors 11 per cent, and others. Thus the chief strength of Siberian trade is concentrated in provisions, clothing and shoes. Part of these goods is prepared on the spot, but a considerable proportion is imported ready made from European Russia.

To elucidate the character of the exchange between Siberia and European Russia, it is necessary to turn to the returns of the Ural Railway, or rather to those of two of its stations, Tiumen and Tura, which no freight escapes in whichever direction it is going. On examining the goods traffic over the said line, it is not difficult to see that the principal mass, going in the direction of the basin of the Volga, is composed of raw materials and half manufactured productions of agriculture and cattle rearing, while in the opposite direction to the basin of the Obi go principally the productions of manufacturing industry. In the first case the chief articles are grain, flour, flax and linseed, tow, nuts, tallow, butter, hair, wool, hides, skins, furs; in the second, cloth, haberdashery, groceries, dry goods, metals, porcelain, glass, spirit, sugar, tobacco, mineral oils. The goods of the latter kind forwarded to Siberia trough Tiumen and Tura amounted in 1888 to 2,269,000 pouds, in 1889 to 2,299,000 pouds, in 1890 to 2,587,000 pouds. In the contrary direction, that is, towards European Russia, these stations forwarded in 1888, 4,799,000 pouds, in 1889, 3,676,000 pouds, and in 1890, 4,787,000 pouds. The returns for 1891 as well as certain details on the goods traffic are given further on under the description of the water ways, as up to the present time this system of conveyance is almost the sole existing.

Passing to a review of the most important trade centres, it must be observed that the scanty population scattered over the boundless expanse of this country by virtue of historical and still more geographical conditions could not be concentrated in large centres and therefore in Siberia to the present day there are but 28 towns counting more than 5,000 inhabitants. Of these the most largely populated are Irkutsk 44,000, Tomsk 40,000, Omsk 34,000, Vierny 25,000, Tobolsk 20,000, and Semipalatinsk 18,000.

The home trade is mainly concentrated in the towns named and consists partly in the barter of the raw materials produced by the natives, partly in the sale for cash. It is everywhere in the hands of a few persons, who availing themselves of the difficulty of communications and the absence of competition in consequence of this, not seldom raise the prices exorbitantly upon all goods, especially woollens and cottons. Some years ago a corner was arranged among several liquor merchants, and the prices of alcohol rose so high, that the Government thought good to despatch a considerable party of spirit from Odessa to Vladivostok, for sale there in the Government warehouses at a fixed price and thus compel the ring to return to the normal course of business, a result which ensued iu the shortest possible time. What kind of goods are for sale appears from the trade returns quoted above. It must be observed that trade has not always a constant character but often becomes more lively at certain times and places during fairs.

Fairs in Siberia possess a great importance and they are there very numerous, but their business is not great. The existence of these institutions is dependent upon the inadequacy of communications, the difficulty of transport, the inconveniences of frequent travelling

and other such circumstances which compel the traders to assemble at a determined time and place, whither merchants come together from every part with their goods.

The most ancient and important Siberian fair is that of Irbit, founded in 1643, administratively forming part of the government of Perm, that is, of European Russia, but geographically an integral part of Siberian territory. Situated at the confluence of the Irbit and the Nitsa, tributaries of the Tura, Irbit forms the half-way house for a number of routes. The fair there is open from the 1st of February to the 1st of March, and for this month the little town wakes up and welcomes 12,000 to 15,000 strangers, doing a business of 40,000,000 to 50,000,000 roubles each time. In 1868 various goods were brought to this town to the amount of 37,311,000 roubles, of which 34,359,000 roubles worth were sold; in 1876, the figures were 49,029,000 and 45,987,000 roubles respectively; in 1891, 45,896,200 and 39,302,700 roubles. The decline in the turnover of the Irbit fair here perceptible is in direct dependence upon the completion of the Ural and Samara-Zlatoust railways. The opening of the Great Siberian Railway will undoubtedly still further diminish the importance of this fair. The chief articles of trade there, after tea, are peltry, honey, wax, nuts, hardware and cutlery, woollens and cottons. The wares for sale here are mostly of Russian origin, although foreign productions from both Europe and Asia are not unknown. In 1891 Russian goods were imported to the amount of 39,274,000 roubles, including in this sum 6,062,000 roubles of Asiatic wares, of which 34,058,000 roubles worth were sold. The corresponding figures for foreign productions were 6,622,000 roubles and 5,245,000 roubles respectively.

The chief article of commerce in the Irbit fair, tea, will be discussed further on. As far as regards fur goods, it may be observed that already now with the approach of the general railway system to the water systems of Siberia the most valuable goods of this kind are forwarded direct to Moscow, without passing through Irbit. Thus, in January of the current year, 1893, a party of sable of 1,700 skins was forwarded to Moscow and sold there for 100,000 roubles. Judging by the course taken by fur goods for some years past, it may be confidently expected that with the building of the western section of the Great Siberian Railway the whole of the fur goods from the basin of the Obi will be forwarded direct to Moscow. In the current year there were 5,450,000 squirrel skins brought to the fair, and 1,500,000 hare skins. The sale of sable was 3,600 skins at 60 to 75 roubles apiece. Light sable was offered to the number of 30,000 skins. There was further a large show of arctic fox, 25,000 skins, krestovatik, nekliui, and other furs. A considerable portion of the furs at the Irbit fair is acquired for foreign export, namely, all the ermine, kolonoks, krestovatiks, bears, marmot, hares, squirrel tails, black and striped cat for Leipzig, sable for Leipzig, Paris and London, squirrel, wolf and fox, for Leipzig.

Combining the above data with the returns on the seal trade, it may be seen that the trade in Russian furs, and particularly in the more valuable kinds, is principally concentrated in London and Leipzig. Both these markets receive from Russia the goods in the raw state and often return them finished, although they most frequently are disposed of in other countries.

Another fair in the same government of Perm, but on Siberian territory, is Krestovsko Ivanovskaya. By the business done there it occupies the next place to that of Irbit. It opens

on the 20th of August and continues 15 days, that is to the 5th of September. In 1868 goods to the value of 4,397,000 roubles were brought to this fair, of which 3,794,000 roubles worth were sold; in 1876 the business doubled, the figures being respectively 8,650,000 and 6,552,000 roubles; in 1891, the business again declined, the goods brought amounting to 5,756,000 roubles; in 1892, there was a further fall, to 4,942,000, of which only 3,783,000 roubles worth were sold.

The third considerable Siberian fair, the Nikolsk, takes place in Ishim in December, from the 1st to the 25th, and has a special object. Here is carried on the trade in the produce of stock breeding, mainly tallow, butter and hides. The total business of the fair amounts from four to five million roubles per annum. The Nikolsk fair determines the prices for tallow and the character of the trade in this article, although the latter is for sale in many other fairs. The total offer in the winter is as much as one million pouds of tallow, the greater part of which is forwarded to the port of St. Petersburg for export, chiefly to England. During recent years, however, in consequence of the enlivenment of manufactures based upon tallow within the Empire, the destination of this article has somewhat altered. Tallow is not only obtained from the local cattle, but most of all from cattle driven from the Kirghiz steppes to the fair near lake Toinchi-Kul in the territory of Akmolinsk. At this fair about half a million head of small cattle and about 100,000 head of large cattle are sold.

Fully half a million roubles worth of butter is brought to the Ishim fair, where it is bought up principally for Moscow, St. Petersburgh and Rostov-on-Don. The butter is taken from the fair to Ekaterinburg, the centre of this trade. Here it is melted, clarified and forwarded in the summer per raft by the Kama to St. Petersburgh and Rostov, and in winter it goes to Moscow in the form of k o l o b o v o e. Besides the three fairs considered, possessing importance exclusively for Siberia, several others may be pointed out, in Perm and in the neighbouring government of Orenburg, in the district of Cheliabinsk. At these fairs the chief trade is in Siberian produce and goods destined for Siberia. Independently of this in Siberia itself there are reckoned more than 160 fairs, of which in the government of Tobolsk 95, in the territory of Akmolinsk 30, in the government of Tomsk 19, in the territory of Semipalatinsk 13, in that of Transbaikal 11, in the government of Yeniseisk 8, in that of Irkutsk 9, et cetera. They last not less than three days.

In the small Aniuisk fort in the Kolymsk district of the Yakutsk territory there annually assembles the so-called Chukche Fair which brings together for the purposes of trade and the payment of y a s a k, or the tax in furs, natives belonging to the most various tribes. Among them are the three divisions of the Chukches, Olenny, Nosovy and Anadyr, and represetantives of the Toungouz, Lashuts, Yakutsk, and Chuvans. The Chukche Fair however has latterly been less frequented, the inhabitants of the Coast finding it possible to exchange their productions for American goods brought them in the shape of contraband in the whalers. This illicit trade is accompanied by frightful exploitation of the native population and their depravement by drink. Various measures have been taken by the local government authorities to combat this evil.

In the territory of Semipalatinsk the trade is mainly carried on between the Cossacks

and peasants on the one hand, and the Kirghiz on the other. In the first case it is on a cash basis, in the second on that of barter.

In the Akmolinsk territory the chief subject of trade is cattle and their produce. In 30 local fairs in 1889 business was done in these articles to an amount of 8,000,000 roubles.

Trade with the natives in the Littoral territory is somewhat peculiarly situated. Almost all the natives are here in dependence on traders of different nationalities. Golds and Oroches have fallen under the influence of the Chinese. The latter supply them goods on credit, but secure themselves the whole of the native's future take of furs, getting the same for a trifle. The Tunguses are in the same dependence on the Yakut traders. As regards the shore tract and Kamchatka, here it is the Russian element that predominates.

In the territory of the Amour, chiefly at the confluence of the large tributaries Zeya and Bureya with the Amour, native fairs with barter take place. The best known on account of the extent of its commercial transactions is the Kiman native gathering on the Bureya. Here 3,000 sables are sold annually fetching 60,000 roubles, and other furs to the amount of 10,000 roubles. In the total for 1889 the imports into the Amour territory of Russian goods amounted to 2,500,000 roubles; and foreign, 1,000,000 roubles, or in all, 3,500,000 roubles.

CHAPTER XIII.

The Foreign trade of Siberia.

The Far East in reference to customs; the import and export of Russian and foreign goods; Vladivostock and Nikolaevsk; trade with China across the land frontier; ports of the Arctic Ocean; the Commander Islands; tea trade over the European and Asiatic frontiers; Bohea and brick teas; freights; tea traffic by rail; western China and Turkestan.

THE vast territory of Siberia is washed on the north along an immense extent by the Arctic Ocean, and therefore on this side during the greater part of the year it is closed for navigation, and even during the season of navigation nature in the polar zone offers so many inconveniences to the establishment of regular navigation that up to the present time the appearance of steamers on the northern coast of Siberia is more or less accidental, not yet possessing any industrial importance.

The eastern zone, bathed by the waters of the Pacific Ocean and possessing for the greater part a more moderate climate, has many advantages over the northern. Here indeed, during the brief period since the establishment of the Russian dominion, an increased movement in the shipping has been observed, accompanied by a more lively trade. On the south, Siberia is conterminous with Manchuria, Mongolia and China. Here there are several land routes. by which the exchange of goods takes place between Russia and the countries named. The development of trade relations with the Chinese Empire always formed the subject of special anxiety to the Russian Government, striving to negotiate various privileges for this trade and to open to it new markets within the limits of the Chinese dominions. In the middle of the present century, besides the commercial relations taking place on the basis of the Treaty of Kiakhta (1727) through Kiakhta and Urga, trade was opened by the Kuldzha Convention (1851) on the side of Ilya aud Tarbagatai. Subsequently the Aikhun Treaty (1858) authorized mutual trade to the subjects of both countries, living along the rivers Amour, Ussuri, and Sunguri, while that of Thian-Tzin (1858) granted Russia the right to carry on trade not only by land but also by sea in the ports opened to foreigners. Finally by the treaty of St. Petersburg (1881) the districts lying on both slopes of the Thian-Shan, as well as Su-Chow, were opened to Russia. Both in these districts and in Mongolia, Russian subjects may trade duty free. Upon goods forwarded to the provinces of the interior and exported therefrom, the Chinese authorities impose import and export customs dues.

In consequence of the sparse population of Eastern Siberia and the inadequacy of its communications, on the one hand, and with the object, on the other, of affording new settlers certain privileges for getting necessary provisions and implements of labour, it was thought best from the very beginning of the annexation of the Amour territory to authorize free foreign trade in the Kamchatka region (1855), and in the ports of the Amour region and the Island of Saghalin (1857). It was at the same time declared that foreign goods might enter free of duty in Russian vessels, and ascend the Amour without any restriction. Foreign vessels on the other hand were not permitted to navigate the Amour higher than the Mariinsk Post, even under the Russian flag. It was soon thought advisable to extend the right to free trade in foreign goods granted to the Amour region to all the ports of the Littoral territory of Eastern Siberia, which was done in 1860.

On the review in 1862 of the statute on the organization of the customs office in Eastern Siberia it was defined that European and Colonial goods forwarded through the ports of the Littoral and Amour territories on arriving at the Irkutsk customshouse are subject to the payment of customs duties on the basis of the general customs tariff on European trade. From goods however despatched by the route mentioned, and intended for consumption within the limits of the said territories, customs duties as before were not exacted. Subsequently certain exceptions were admitted in this respect, and from 1867 the import of intoxicants was made dutiable, and from 1887 tobacco goods were also brought under this exception. Next, on nearer acquaintance with the position of the home trade of Eastern Siberia and in the interests of the normal development of the national industry, it was found necessary to impose customs duties upon all imported foreign goods which are subject to excise within the country. This measure was called into existence among other things by the abnormal direction taken by our export trade. Goods subject to excise and destined for export from European Russia into Eastern Siberia were declared as exported abroad, the exporter receiving in the shape of drawback the whole of the excise paid by him and in some cases a premium on the export. These goods were then imported as foreign into the ports of the Littoral. Thus in order to obtain the premium on sugar it was necessary to forward it first to some foreign point, for example Port Said, and then import it as foreign into Vladivostok. Something of the same kind took place in the tobacco trade. Hamburg traders taking advantage of the circumstance that Russian tobacco goods on shipment abroad do not bear any internal excise began to order them in St. Petersburg and despatch them to Vladivostok as German productions. If these goods were forwarded direct from the interior governments of the Empire to Vladivostok without banderole they had to pay export in that port. Approximately the same thing took place in reference to other goods, such as petroleum illuminants, matches, et cetera. Thus Russian productions in the Russian ports of the Pacific Ocean were in a depressed state, which of course could not be regarded as normal or desirable. To regulate the trade, and at the same time preserve to Eastern Siberia its privileged position, as regards the duty free enjoyment of foreign productions, from 1888 the ports of the Eastern strip of Siberia were opened for the duty free importation of all goods with the exception of the following: sugar, molasses, confectionery, jam, fruit in syrup, in liqueurs et cetera, arrack, rum, French brandy, spirituous liquors imported in bottles, gin, whiskey, wines made from grapes, mead, porter, mineral

illuminating oils, paraffin lubricating oil, spirit and oil polishes and matches. To the articles named, when imported into the ports of the Littoral territory, the actual customs tariff on the European frontier is extended. Tobacco goods of foreign origin imported by sea into Vladivostok and Nikolaevsk, as well as Russian, not bearing the legal banderoles, are made to pay duty on the basis of the general tariff at the European frontier. The collection of the duties upon goods imported into the ports of the Littoral territory, on account of the absence there of customs institutions, is imposed upon the officials of the local excise control. On the publication of the law quoted, imposing import duties on certain goods, the question arose as to whether duties should be taken from the foreign goods enumerated above when imported into the Commander Islands, and into Petropavlovsk, and other northern ports of the Littoral territory, for which no special exceptions are established. Taking into consideration the poverty of the population of the northern zone of the said territory and of the islands of the Pacific Ocean and also the total absence there of excise officials, it was thought advisable in 1889 to limit the exaction of customs duties from certain foreign goods imported into the ports of the territory of the Littoral to the ports of Vladivostok and Nikolaevsk, with the condition that the exaction of such duties should be effected on the same general basis from the goods also that may be imported into the said ports from other ports of the Littoral territory.

Thus up to the present time the immense territory of Eastern Siberia continues to remain in the position of a free port for the mass of foreign goods, which however does not offer any danger for the importation of duty free merchandise through Eastern into Western Siberia and further into the interior of the Empire.

Notwithstanding the natural wealth of Siberia and the favourable climatic conditions existing in many localities, its productivity in consequence of its scant population and absence of communications is extremely insignificant, and it is in need of the importation from without of many such essential articles, as under other circumstances might be successfully produced upon the spot. Siberia is mainly furnished with the necessary productions by importation from the following countries.

From European Russia it receives cheap cottons and woollens, tobacco, spirit, sugar, illuminants, articles of leather and iron, writing paper and a small quantity of haberdashery and articles of fashion. From Great Britain, Siberia receives chiefly cotton and woollen yarn and fabrics, iron, tin-plate et cetera. From Belgium, glass and yarn, are imported; from France, articles of fashion, preserves, wine et cetera.

The United States of America carry on a pretty brisk trade with Siberia through San Francisco, furnishing that country with flour and other articles of food, machinery and agricultural implements, leather goods and guns.

Germany, thanks to the activity of many German firms in Nikolaevsk and Vladivostok, has a predominating influence in the import trade of Siberia. It furnishes the most various goods, although of a very inferior quality, such as furniture, sugar, wine, kitchen utensils, cottons and woollens.

Korea sends to Siberia the produce of its agriculture and cattle rearing, grain, vegetables and cattle. Japan imports mainly wheat, rice, salt, fruits, and to a very limited

extent, articles of luxury. China carries on a large trade with Siberia in tea; the importation of other goods takes place on a small scale bearing a more or less casual character.

The chief articles of Siberian export through the Pacific ports are the produce of the whale and morse industries, furs, sea cabbage and fish. The remaining articles, namely timber, coal from Saghalin, trepang or sea slugs and ginseng, have as yet hardly any industrial importance.

Foreign goods enter Eastern Siberia mainly through Vladivostok, Nikolaevsk on the Amour, Blagoveschensk and Ayan in the Yakutsk territory. By not one of these four routes can duty free goods penetrate into Western Siberia while avoiding the Irkutsk Customshouse. Merchandise from Nikolaevsk proceeds to Sretensk almost 3,000 versts by the Amour only from May to September; in winter about four months this route is still by the Amour over ice, while in the remaining spring and autumn seasons of the year Nikolaevsk is quite cut off from the country, with which accordingly all relations for the time cease. Other route than the Amour there is none. Goods from Sretensk inevitably take the direction of the Lake Baikal where are situated customshouse posts. From Vladivostok goods go by sea and land. In the first case, they are forwarded to the ports of the Sea of Okhotsk, to Kamchatka, the Island of Saghalin, the harbours of Possiet and St. Olga, De Castri bay and others. In the second, the goods go to China, Korea, Khabarovka and various settlements along the Ussuri and again fall into the basin of the Amour. As for the route through Ayan, on account of the entire absence of population in this locality, the importation of foreign goods through the territory of Yakutsk for a long time to come will be unable to assume any appreciable dimensions.

The subjection of articles paying excise to a customs tariff has not so much a fiscal character as the object of regulating the relations of importation of foreign and home productions.

The imports of foreign goods paying duty into the Littoral territory in 1891 were expressed by the figures, 8,000 pouds, valued at 117,689 roubles, the articles being as in the following table.

Goods imported:	1890.	1891.
Tobacco in the form of cigars and cigarettes . .	—	15 pouds
Raw and refined sugar	587	61 »
Confectionery, jams, syrups	—	20 »
Arrack, rum, grain spirit	60	69 »
Arrack, rum, French brandy	2,506	2,529 bottles.
Wines made from grapes and berries	972	1,522 pouds.
» » » » » » still	1,804	2,298 bottles.
» » » » » » effervescing .	4,097	5,049 »
Mead, porter, beer, cider	614	979 pouds.
» » » »	8,599	24,296 bottles
Liquid products of the distillation of naphtha .	1,416	104 pouds
Spirit, turpentine and oil polishes	—	5 »
Matches	1,182	2,370 »

Only the goods named paying duty are capable of a more or less accurate estimation. As for other goods, they are accounted for only in Vladivostok and Nikolaevsk; in the other ports of the Littoral they escape notice, so that the import returns into this territory are restricted to dutiable goods.

Of the merchandise imported to Vladivostok, about 25 per cent are cottons and woollens; 15 per cent, grain and flour, and 10 per cent, other provisions. Next in order follow, articles made of metal, sugar, spirit, metals, et cetera. In the supply of these goods, Germany plays the first part, providing about 30 per cent of the whole imports. From European Russia come 25 per cent; from England, 13 per cent; from China 12, Japan 13, America 5 per cent, and so on. After the imposition of duty upon certain foreign goods, Russian productions began to be imported in greater quantities, although foreign production still predominate, as appears from the trade returns of Vladivostok for the three years given below.

Year.	Goods imported, in roubles.		
	Total.	Russian.	Foreign.
1887	5,741,467	2,016,227	3,725,240
1888	5,884,508	2,120,987	3,763.521
1889	5,709,544	2.384,722	3,324,822

The distribution of the imported goods among the traders according to their nationality takes the following form.

1889.	Russian subjects.	Foreign subjects, European and American.	Japanese.	Chinese.	Coreans.
Russian goods	1,284,386	1,083,610	4,995	8,731	—
Foreign	231,765	1,660,196	182,997	1,248,997	1,310
Total . .	1,516,151	2,743,806	187,992	1,257,728	1,310

The above table shows that the trade in Vladivostok is mainly concentrated in the hands of foreigners, namely 73 per cent; the Japanese and Chinese trade chiefly in the productions of their respective countries.

The export from Vladivostok is on the whole small, the principal articles being the products of the whale and morse industries, to the amount of one and a half million roubles, and various furs valued at one million roubles. Next follows sea cabbage, of which 250,000 roubles worth is forwarded to various destinations every year; p a n t a, 35,000 roubles; timber, 30,000 roubles; trepang, 15,000 roubles; and other goods to the value of 250,000 roubles. Thus the total export of Vladivostok may be estimated at three million roubles. Vladivostok, forming the terminus of the Siberian Railway, with the latter's completion, will undoubtedly

occupy an extremely important position in a commercial sense. Already during the last decade a considerable increase has been observed in the annual arrivals of shipping, while the quantity of freights has grown by 200 per cent. Simultaneously with the construction of the line a commercial port will be built there, with whose completion there will be a brisker movement in the shipping.

The trade of Nikolaevsk bears a somewhat different character; from this point for fully 3,000 versts there is a magnificent water way into the interior of the country, thanks to which Nikolaevsk has greater reason to be considered a point of transit than Vladivostok. Of the total imports of Nikolaevsk 35 per cent consist of tea, 11 per cent sugar, $10^1/_2$ per cent various machinery and locomotives, 9 per cent manufactured goods and 8 groceries. The population of Nikolaevsk being inconsiderable, the whole mass of goods is not consumed on the spot but forwarded thence up the Amour.

In supplement to the data on the importation of goods into Nikolaevsk and Vladivostok, may be quoted further the returns on the number of ships that visited these two ports of the Eastern Ocean.

Vladivostok.

Year		Steam.	Sailing.	Total.
1873	Russian .	3	7	10
	Foreign .	1	18	19
1877	Russian .	5	2	7
	Foreign .	11	19	30
1880	Russian .	17	—	17
	Foreign .	25	29	54
1884	Russian .	26	1	27
	Foreign	31	15	46

Nikolaevsk.

Year		Steam.	Sailing.	Total.
1877	Russian .	4	3	7
	Foreign .	3	12	15
1880	Russian .	5	1	6
	Foreign .	7	7	14
1884	Russian .	6	2	8
	Foreign .	11	4	15

The data on the arrival and departure of vessels in the said ports in 1891 appear in the following table.

	Arrivals.						Departures.					
	Total.		Sailing.		Steam.		Total.		Sailing.		Steam.	
	Vessels.	Tonnage.	Vessels.	Tonnage.	Vessels.	Tonnage.	Vessels.	Tonnage.	Vessels.	Tonnage.	Vessels.	Tonnage.
Vladivostok . . .	111	48,569	9	658	102	47,911	108	47,612	7	555	101	47,057
Nikolaevsk	33	9,347	6	541	27	8,806	33	9,347	6	541	27	8,806
	144	57,916	15	1,199	129	56,717	141	56,959	13	1,096	128	55,863

Thus, from the data quoted it appears that the number of ships arriving at the two chief ports of the Siberian shore of the Eastern Ocean is increasing every year, and there can be no doubt but that with the improvement of the navigation on the Amour and the opening of the Ussuri branch of the Great Siberian Line this growth will go still faster.

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Passing to the review of the foreign trade of Siberia across the land frontier with China, Mongolia and Mantchuria, it must be observed that the trade in this direction, although it has been carried on from the earliest times but in consequence of the absence of roads alike within the limits of Siberia and in the conterminous states, has for a long time kept within the same bounds, and with the increase of trade in the navigations of the Amour basin and in the Great Ocean the land trade is apparently diminishing. The most important route in this direction is the natural road connecting the industrial centres of the Celestial Empire through Urga and Maimachin with Kiakhta and Irkutsk, and consequently with the great Siberian tract. Other less important roads, two in number, connect Western China with the territory of Semipalatinsk. Along these principal ways the export of goods from Siberia does not exceed two to three million roubles a year. The import, on the other hand, reaches fourteen to fifteen millions. But if from the latter figure be excluded the value of the tea imported through Kiakhta into European Russia, as this article to a considerable extent is merely in transit as far as Siberia is concerned, the total value of the imported goods will be found to correspond to that of the exports. The chief subject of export is the produce of cattle rearing, and that of import, is tea.

The table below gives the total values of imports and exports, while it must be borne in mind that the Semipalatinsk Customs district does not exactly correspond with the boundaries of the territory of the same name, including as it does part of the Turkestan country. In consequence of this the corresponding figures will differ somewhat from the fact.

1891. Exported.	Semipalatinsk Customs district (with China.	Trade with Urankhai.	Irkutsk Custom-house through Kiakhta (with China).	Littoral territory [3].	Total.
Provisions	73,063	5,688	8,146	—	86,897
Raw and half-manufactured materials	190,091	34,439	682,473	—	907,003
Animals	109,948	—	6,926	—	116,874
Manufactured goods	1,119,440	58,044	850,932	—	2,028,416
Total . .	2,168,963 [1]	98,171	1,548,477	—	3,815,611
Imported (examined).					
Provisions [4]	50,317	9,813	11,817,795	70,594	11,948,519
Raw and half-manufactured materials	373,848	13,974	169,821	880	558,523
Animals	162,457	77,301	—	—	239,758
Manufactured goods	111,701	170	589,166	46,215	748,252
Total . .	762,446 [2]	101,258	12,576,782	117,689	13,558,175

1. Including 676,421 roubles worth of goods, not accounted for in detail. 2. Including 64,123 roubles worth of goods not accounted for in detail. 3. Per Vladivostok and Nikolaevsk, in the import only dutiable goods being shown. 4. Included tea.

Almost all this barter trade takes place between Siberia and China, while in respect to export the first place is occupied by Semipalatinsk through which about 60 per cent of all the goods exported pass. The imports on the other hand took place mainly through Irkutsk and Kiakhta. The export of Russian goods through Kiakhta during the last six years appears from the following table:

Goods exported.	1886.	1887.	1888.	1889.	1890.	1891.
	Roubles.					
Provisions	83,030	27,623	7,033	2,434	5,532	8,146
Raw and half-manufactured materials	794,400	999,094	926,119	688,361	601,667	682,473
Animals	5,429	11,874	10,392	11,502	9,800	6,926
Manufactnred goods . . .	732,315	1,416,181	1,560,023	485,515	536,458	850,932
Total. . .	1,615,174	2,454,772	2,503,567	1,187,812	1,153,457	1,548,477

The value of the exports under the first article, foodstuffs, is extremely small, and is composed mainly of that of grain whose export is subject to great fluctuation.

The second article, more important, is almost entirely formed of the value of various skins and hides, as appears from the data given below for the same years.

	1886.	1887.	1888.	1889.	1890.	1891.
		Roubles.				
Skins, sheep and goats	65,959	33,183	7,200	—	—	—
» wolves, foxes and lynx .	205,671	245,032	300,961	264,012	141,234	112,058
» otters, beaver, and bear .	8,603	—	19,319	40,900	22,536	22,590
» various	177,205	159,743	81,714	75,159	64,965	130,774
Russia leather	199,921	303,597	314,278	165,290	194,397	261,275
Tanned hides, except Russia leather	51,954	65,346	56,173	18,305	26,170	13,020
Horns and hoofs	51,407	150,089	126,382	102,852	138,370	139,978

As for the export of manufactured goods, this article is almost entirely confined to the export of cloth, linen and cotton fabrics, exported during the period under consideration as follows.

Goods exported.	1886.	1887.	1888.	1889.	1890.	1891.
	Roubles.					
Cloth	298,404	695,832	637,590	85,674	118,587	158,289
Linen and hemp goods .	—	62,114	56,914	—	31,679	16,384
Cotton goods	370,681	550,929	772,788	512,643	540,197	897,951

The imports to Russia from China through the Irkutsk Customhouse, corresponding to Kiakhta, consist to the extent almost of 98 per cent of tea. The following gives a general view of the imports across this frontier for the same years.

Imports:	1886.	1887.	1888.	1889.	1890.	1891.
	R	o	u	b	l	e s.
Provisions	29,948,230	30,034,486	17,761,209	16,693,746	14,213,274	11,817,896
Raw and half-manufactured materials	6,941	18,838	46,646	54,364	41,337	169,975
Manufactured goods	98,176	52,816	93,757	113,268	266,325	594,464
Total . .	30,053,347	30,106,140	17,901,612	16,861,378	14,520,936	12,582,335*

On examining the totals of this table for the last six years, a diminution of the imports from thirty millions to twelve million roubles will be noticed, which is caused not only by the diversion of tea cargoes to the sea route, as will be explained later in detail, but mainly by a change in the system of valuation of tea adopted recently, namely instead of the value of tea in retail trade, 60 roubles a poud, the price of tea at the frontier is taken before the payment of duty, about 20 roubles per poud. In fact this diminution is still more considerable as the sum shown includes goods not only received by land through Maimachin-Kiakhta but also by the Amour. It is true that by the latter route comparatively little is received, but in the gross these imports prove to be an appreciable quantity. Thus for example, the value of foodstuffs passing through the Irkutsk Customs in 1891 is composed as follows.

Teas.	Pouds.	Roubles.
Bohea tea	260,728	5,766,323
Brick » (kirpich)	593,806	5,571,841
Cake » (plitka) .	32,610	450,321
Total . . .	887,144	11,788,485

Of the quantity of tea shown, there were brought by the Amour 234 pouds of Bohea tea or less than $^1/_{10}$ per cent; 21,516 pouds of brick tea, or about 4 per cent. Thus through Irkutsk besides tea there passes about one million roubles worth of other foodstuffs.

Speaking of the foreign trade of Siberia it is impossible not to refer to one more article, namely timber, which in the near future must become an important item of Russian export. As a matter of fact, with the vastness of the forest plantations of the Far East, and the absence of any attempt at using them for industrial purposes, these resources till now are lost, bringing the country no advantage. And yet the immense country at the very doors

* Of which to the value of 5,553 roubles were received by post.

with its four hundred million population suffers from a deficiency of timber, which it might obtain with the greatest advantage for itself from Siberia.

In the interior provinces of China, almost entirely bereft of forest vegetation, timber is sold by weight and extremely dear, seeing that it has to be supplied from very remote places, not seldom a thousand versts away, on the backs of camels. It is true that timber might be furnished to China from Mantchuria, the northern portion of which is yet covered with virgin forest, but it has been preserved there in such an inacessible situation, that the export and carriage to the chief markets of consumption will be very expensive. On some of the Japanese islands there is also still forest, but in Japan itself there always exists an unfailing demand for that article. Under such circumstances advantage should be taken of the forest wealth of the Amour and Littoral territories, and yet, although since 1863 there have been not a few attempts of the kind, the enterprise has not been attended with success. The timber was exported in the green state, simply hewn without any shaping, in consequence of which its transport came very expensive. On the other hand the same article was received by China from California in a perfectly dry and seasoned condition, sawn and cut up for various purposes. Thanks to such foresight on the part of the American traders, they have a predominating influence in the whole timber trade of China.

In 1863 the first attempt was made to facilitate and regulate the export of timber from the Littoral territory, but it ended in failure. In consequence of the placing of a duty upon the goods destined for export the trade was unable to take root.

Passing to the review of the participation of the separate territories of Siberia in the foreign trade, it may be noted that the most important part in this respect, as far as imports are concerned, falls to the Transbaikal territory, thanks to its direct relations with China via Irkutsk and Kiakhta. Besides the last point the foreign trade of the Transbaikal territory is carried on further via the following centres: Tsurukhaitui, Abagaitui, Tsagan-Olui, and the station of Verkhneulkhunsk, through which in 1889 there were exported into Mongolia animals, animal produce, manufactured goods et cetera, to the amount of 112,849 roubles, while in 1890 the export fell to 69,851 roubles. Through the same centres there were imported from Mongolia various animal produce, animals and tea, in 1889 to the amount of 93,403 roubles, and in 1890 to that of 90,112 roubles.

The Siberian ports of the Arctic Ocean in reference to the importation of foreign goods are on the whole brought under the Customs tariff for the European frontier. But in view of the special peculiar local circumstances not unfrequently duty free importation of foreign goods is authorized by a special Imperial order. And yet the northern shores of Siberia are rarely visited by foreigners. The most important place of importation is the mouth of the Yenisei, whither in 1890 came the steamers of the Anglo-Siberian Company. These steamers were loaded with 24,108 roubles worth of provisions, 130,076 roubles worth of raw and half-manufactured materials, and 214,000 roubles worth of manufactured goods. The flotilla ascended the Yenisei, and their freights reached the towns of Krasnoyarsk, Irkutsk and Tomsk. Although these goods were freed from Customs duties, and the same privilege was even extended to the navigation season of 1894 inclusive, neither in 1891 nor in 1892 was there any importation by this route. The English steamers on their return cruise took on board grain and meat.

The Commander Islands forming part of Siberia from an administrative point of view do not present great commercial interest. The exports thence are confined to skins, of which, in 1891, 319,000 roubles worth were despatched, in 1892, 365,000 roubles worth in gold. The imports on the other hand do not exceed 50,000 roubles worth, more than half of the goods coming from America. The figures given here for the value of the skins are calculated only on the Crown tax accruing from them.

The tea trade: From the sketch just presented of the foreign trade of Siberia, it appears that of all the foreign goods imported by land into Siberia or passing through in transit, tea deserves the greatest attention, forming as it does by its value fully 98 per cent of all the imports. And although, as will appear further on, the impottation of tea into the Empire via Siberia is declining with every year, yet by its value this article continues even now to occupy the first place in consequence of which it is not out of place to examine somewhat more in detail the routes by which tea travels from China through Siberia, and to elucidate the causes of the decline in its transport through Siberia.

The tea trade with China has existed in Russia fully two centuries. In 1802 only 45,000 pouds were imported of Bohea and brick tea. In 1820 the amount was about 100,000 pouds. In the middle of the present century this figure was trebled, and from the end of the seventies the trade grew particularly fast, thanks to the direct communication established by the Volunteer Fleet between Odessa and the Siberian ports of the Pacific Ocean.

In the last decade however a certain steadiness has been observable, the figure of the imports has fluctuated about two million pouds a year, the direction of importation only changing, that is, overland or by sea.

Year.	Total, pouds.	European frontier.	Irkutks Customs.
1887	2,021,095	607,320	1,429,914
1888	1,921,472	695,367	1,210,769
1889	1,914,565	702,001	1,188,971
1890	1,916,985	834,720	1,001,940
1891	1,964,790	743,810	1,109,698
1892	2,142,107	798,980	1,217,046

As tea in some cases is imported free of duty it follows that the consumption is somewhat greater than above stated. The data on the importation from 1877 to 1891 inclusive show that the imports across the European frontier are increasing, although unevenly. In the quinquennial period 1877 to 1881, 748,500 pouds were imported; in 1882 to 1886, 885,600 pouds, and in 1887 to 1891, 782,900 pouds. Brick tea was imported in the first five years to the extent of 843,800 pouds, in the second five years to that of 972,100 pouds, and in the third, to that of 1,171,200 pouds. The total quantity of imports changed in the following manner: in the first period, 1,593,000 poud, in the second, 1,890,000 pouds, and in the third, 1,982,000 pouds.

In explanation of the considerable importation noticeable via the Irkutsk Customhouse in 1887, it may be observed that this year was exceptional, a certain firm beginning to operate unsuccessfully with brick tea. It imported an enormous quantity of this article, which naturally did not at once find a buyer and which for three years produced a pressure upon the normal trade in brick tea. A more just idea of the course of the tea trade through the Irkutsk Customhouse may be formed by the comparison of the following figures upon this question. They show the quantities of tea cleared by the Irkutsk Customhouse during the period under consideration.

Years.	Bohea.	Brick.	Cake.	Total.
	Thousand pouds.			
1887	472	927	—	1,429
1888	473	738	—	1,211
1889	416	763	10	1,190
1890	303	667	32	1,002
1891	302	775	33	1,110
1892	379	806	32	1,217

Thus the large transport of brick tea in 1887 produced a depression until 1890, from which time the trade in brick tea assumes a more normal character, and the importation of this article steadily increases.

From the figures quoted it is clear that tea is imported into Russia mainly, to the extent of one-half of the total quantity, overland, or through Siberia and the Russian Central Asiatic possessions. The cause of such preference of the land route, although comparatively more expensive than the sea route, will be explained further on.

The main mass of tea is the Bohea which is brought to every part of the Empire and is the more valuable article. Brick tea is consumed only by the Siberian, Kirghiz and Calmuck natives of Eastern Russia, in consequence of which this sort of tea is brought into Russia exclusively across the Asiatic frontiers and knows not the sea route. During the last six years there was imported into Russia and cleared through the Customs brick tea to the following amounts.

1886	768,415 pouds.	1889	762,807 pouds.
1887	957,542 »	1890	668,659 »
1888	737,834 »	1891	777,427 »

Brick tea is imported almost exclusively via Kiakhta and the Irkutsk Customhouse, very little being transported through the Russian Central-Asiatic possessions, in some years the quantity scarcely reaching 1,000 pouds.

However not the distribution alone of the consumers of brick tea influences the direction taken by its transport; the latter is the result in a much greater degree of the tariff estab-

lished for this sort of tea in the different customhouses. According to the customs dues now in operation, the duty on brick tea is levied at the European frontier at the rate of 21 roubles gold per pood, that is, at the same rate as from Bohea, while the same tea passing through the Irkutsk Customhouse pays only 2. 50 roubles. Thus it is evident that to import it into Odessa and thence forward it to Eastern Russia does not present any advantages.

Brick tea, to resume, is imported annually to the amount of about 750,000 pouds. Excluding this quantity from the total importation, it will appear that the most expensive or Bohea tea is despatched principally by sea, there being a strong tendency to conveyance by sea, evident at a glance from the following comparison as regards the importation of Bohea tea, paying duty.

Years.	Total.	Across European frontier.	Via Irkutsk.	Percentage of importation via Irkutsk.
1887	1,065,334	607,320	458,014	43.0
1888	1,168,289	695,367	472,922	40.5
1889	1,117,937	702,091	415,846	37.1
1890	1,137,865	834,720	303,145	26.6
1891	1,046,305	743,810	302,495	28.8
1892	1,041,623	665,070	376,553	36.0

The quantity of Bohea tea imported has remained during the last five years almost without change, the transport in the beginning of the period being divided almost equally between the sea and overland carriage, while in the subsequent years the traffic across the Asiatic frontiers declines, in 1891 only 29 per cent passing in this direction. Judging from this, it might be thought that the sea carriage is so much cheaper than that by overland that the privileged tariff now existing in respect to the importation of Bohea tea through the Irkutsk Customhouse, namely 13 roubles gold per pood instead of 21 by the European Customs, is insufficient. But as a matter of fact this is caused by the steadiness of the freights by the sea carriage, while the cost of the overland carriage is subject to considerable fluctuations and depends on many circumstances. To clear up this side of the question and ascertain the significance of tea freights for the future Siberian Railway, it is necessary to indicate of what elements is composed the cost of carriage of tea overland and by sea.

Bohea tea is imported into Russia mainly from Han-Kow, whence it is despatched by sea through Thian-Tsin to Pekin, and thence to Kalgan, Urga and Kiakhta to Irkutsk. Besides this, a small portion of tea is forwarded to the Irkutsk Customhouse by another route, namely by water. This route is from Han-Kow by sea to Nikolaevsk, then by the Amour to Sretensk, and thence overland. By this last route the carriage to Irkutsk costs two roubles cheaper than through Kiakhta. But the following circumstances are in the way of the successful development of the traffic in this direction. Nikolaevsk is accessible to steamers only during four to five months of the year, from June to October, and even so only for light

draught vessels drawing less than fourteen feet of water. Next come the inconveniences of the navigation in the stormy Tartar straits and in the mouth of the firth of the Amour. Finally there is the roadlessness of Transbaikalia.

The carriage per poud of tea from Han-Kow through Irkutsk to Nizhni-Novgorod, the chief centre of the trade in the tea imported by this route, costs about 18 to 20 roubles.

Carriage from Han-Kow via Thian-Tsin, Pekin and Urga to Kiakhta	7. 28	roubles
Expenditure at Kiakhta and carriage to Irkutsk.	3. 00	»
From Irkutsk to Nizhni	6. 00	»
Insurance from Thian-Tsin to Nizhni (2¼ per cent)	0. 90	»
Percentage on capital invested	1. 43	»
Total .	18. 61	roubles

The goods sometimes are a year on the road; they require extremely careful packing, the sewing of the tea boxes into leather cases, and watchful supervision in transit; all these circumstances make the tea traders prefer the sea route, even although the freight should somewhat exceed the difference in the duties.

The cost of the conveyance of tea via Nikolaevsk, Sretensk, Irkutsk and Nizhni, is composed of the following elements: from Han-Kow to Nikolaevsk with packing, insurance, commissions and other expenses, 2.65 roubles; from Nikolaevsk to Sretensk, including transhipment and various general expenses, 2.30 roubles; from Sretensk by road to Irkutsk, 5.55 roubles, thence to Nizhni 6 roubles; the total, 16.50 roubles.

The sea route is considerably cheaper, from Han-Kow to Odessa, including packing, insurance, freight, commissions, customs duties in Odessa, insurance and carriage further by rail to Nizhni, amounts in all to about 6 roubles. Accordingly, a poud of tea in Nizhni brought thither from Han-Kow via Odessa costs 12.60 roubles cheaper than that imported via Kiakhta, and this difference as a matter of fact almost corresponds to the customs difference of 8 roubles gold.

The customary route, along which from old times tea has passed in transit through Siberia into European Russia, begins at Kiakhta or more exactly at Irkutsk and coincides with the great Siberian tract, which runs from Irkutsk through Tomsk to Tiumen. However the comparative dearness of this route not seldom made the tea traders forward their precious freight by more dangerous roads in the hope of a small reduction in the cost of carriage. Frequently the tea caravans were arrested en route in consequence of the early freezing of the Ket, or Chulym or were damaged on the Angara and Yenisei. But notwithstanding all this they even not seldom avoid the great Siberian tract, passing through Bisk by the Chuisk road or from Kalgan to Uliasutai to the upper waters of the Yenisei and thence are floated down on rafts to Minousinsk. Even when following the great Siberian tract the conveyance of tea with the same view to economy has somewhat changed its character. Formerly tea took this route entirely overland, but now a portion of it from Irkutsk is conveyed by water on the Angara to Yeniseisk, is thence carried in carts to Makovsk on the river Ket, Meletsk or Berliuz on the Chulym, and then by water to Tiumen.

Hence, or more often from the terminus of the Ural Railway, Tura, the tea is mainly transmited to Perm. In 1891 the station Tura despatched 492,261 pouds of tea; among which, 480,941 to Perm, 7,532 to Ekaterinburg, et cetera. The station of Tiumen transmited a total of 165.926 pouds, including 117,423 to Perm, 42,527 to Ekaterinburg, et cetera. Nizhni Tagil in the same year despatched 46,798 pouds, of which 46,273 were to Perm. The forwarding just mentioned of a considerable quantity of tea to Ekaterinburg may be explained, of course, not by local consumption but by the fact that part of the tea from Ekaterinburg is also transmitted to Perm, namely 5,967 pouds, while part is distributed among the other stations of the Ural Railway, 6,598 pouds, and a still larger quantity is forwarded to Moscow by the Samara Zlatooust railway, 19,709 pouds. From Perm the tea is sent by the Kama, and then by the Volga, in the main to Nizhni, which in 1891 despatched 153,032 pouds of this merchandise by rail, the greater part of which was naturally sent to Moscow.

Moscow is the most important centre of the Russian tea-trade, the tea being brought there and then distributed thence throughout the Russian Empire. The tea which passes through Siberia and the Russian dominions in Central Asia is conveyed to Moscow by four routes; the first two have already been mentioned, namely, the Uralsk and Samaro-Zlatooust railways, and also by the Orenburg and Transcaucasian railways. The tea which comes by sea over the Pacific, Indian and Atlantic oceans reaches Moscow principally through Odessa and Graevo, the transit from London through Konigsberg, and partly through the Baltic ports. The total amount conveyed to Moscow in 1890 by all these routes was 1,109,700 pouds or 54 per cent of the whole import. Out of this quantity 969,662 pouds were despatched thence by rail during the same year and the rest was used for local consumption or distributed by carts in the immediate neighbourhood.

When the Siberian Railway is laid the overland transport will naturally be very much cheaper. It will then also be possible, and indeed when even the Eastern portion of the line is completed, to place Eastern Siberia under the same conditions as the Empire as regards customhouse duties, and to stop the free import of tea and put an end to those misunderstandings which arise from the absence of customhouses within the borders of Eastern Siberia. Until 1888 some parts of Western Siberia and Turkestan were also in this privileged position, partly from political and partly from commercial reasons.

Between 1860 and 1870 during the Dungan insurrection which sprang up in western China, gradually spread and finally completely cut off the Chinese tea plantations from the markets of Central Asia, the Russians conceived the idea of profiting by this circumstance in order to take possession of these markets and thrust out the foreign tea dealers from them, as the importation of Chinese tea into Central Asia by the former route through Kashgar had at that time become impossible and the only available one was through Siberia, from Kiakhta to Irkutsk. Under these conditions the Russian tea trade in Central Asia had only to compete with Indian tea, imported from India through Afganistan. For this reason the customhouse cordon which stretched from the Caspian Sea from south to north along the Urals and the eastern frontier of the government of Orenburg to the barrier of Zverinogolovsk, from which point it turned directly to the east and passed along the former southern frontier of Western Siberia as far as Semipalatinsk and the post of Boukhtarminsk, was

abolished in 1868; and besides this, a free import of Kiakhta teas into the government of Turkestan was granted with the unconditional prohibition against the import of any kind of tea thence into the Russian Empire, a duty being also levied upon any tea imported into Turkestan from any of the neighbouring Khanates. On the same grounds, and also in consequence of the impossibility of European merchandise penetrating into Russia by this route and in order to facilitate commercial intercourse with the Khanates of Central Asia, the importation of all kinds of goods from there was allowed free of duty. Experience however, soon proved that the free import of Kiakhta teas into the region of Turkestan did not justify the hopes which had been originally entertained as the inhabitants of Central Asia acquired the habit of using Indian teas and cheap and harmless native substitutes which found a ready sale among the inexacting consumers. The teas of Kiakhta, on account of there comparatively high price were beyond the reach of inhabitants, the majority of which were extremely poor. At the same time it was discovered that a large amount of Kiakhta tea imported duty free into Turkestan, was not consumed in that country but secretly conveyed from there into Russia, thus occasioning considerable loss to the fair-trade. Apart from this, in course of time, the region to which the free import of tea had been granted became changed; it had originally consisted of the provinces of Syr-Darya and Semirechinsk to which the province of Ferghana, the Zaravshansk district and the department of the Amou-Darya were subsequently annexed, and the province of Semirechinsk was incorporated into the domains of the new Governor-General of the steppes.

The economic and political aspects of this border land of Russia also underwent certain essential alterations; Kuldzha which was occupied by the Russian forces in order to terminate the revolt of the Dungans and Taranchins was receded to China and the treaty of St. Petersburg in 1881 accurately determined the frontier between Russia and western China, and also the points for the admission of goods and regulated the interchange of merchandise. The insurrection in western China little by little subsided; the traces of it are beginning to disappear and a regular and busy trade has established itself between Russia and China. Russian manufactured goods have not only penetrated into Kashgar, but have even supplanted the English wares, and Russia has in this way obtained a fairly lucrative distant market. In Kuldzha, in the district of Tarbagataisk and in western Mongolia Russian goods have competed with equal success against those of England. On account of the considerations already mentioned, and also in consequence of the impossibility of establishing a customhouse cordon between Turkestan and the Russian Empire, and also in order to put an end to the abuses in the free tea trade, it was found expedient to cancel the above mentioned privelege in 1888. In order to attain the object in view a customhouse inspection was simultaneously instituted on the frontier between Semirechinsk and China, as China teas might otherwise be imported from Kuldzha into that province free of duty or hindrance.

The high duty on tea renders it profitable to convey it from very distant places so that tea upon which no duty had been levied could easily make its way into the provinces of Semirechinsk and Semipalatinsk, and thence to Tomsk and even penetrate into the interior of European Russia and thus cover a very extensive region.

For this reason in 1890 a customhouse inspection was established on the frontier between Russia and western China within the limits of the government of Tomsk and the provinces of Semirechinsk and Semipalatinsk. This extension of the customhouse line was due to the desire of preventing the diversion of tea freights from the Kiakhta route to a direction less subjected to customhouse supervision. It was also discovered that the most advantageous route for transporting tea was not through Urga and Kiakhta but through Uliassutai and Kobdo. This route is much shorter than that of Kiakhta and at one end of it the goods are delivered at Semipalatinsk and at the other at Biisk, from both of which towns there is regular steamer service to Tumen, the freight by steamer or barge to Tumen being about 25 kopecks. Finally, transporting tea by this route obviates the necessity of the expensive process of sewing up the tea in skins, as the Chinese carry the packets in horsecloths or in blankets, which they take back afterwards, and on the steamers or barges it is not necessary to take precautionary measures for preserving the tea.

This is a brief account of the part played by Siberia in the Russian tea trade; it is a very important, and when the Great Railway Line is opened even as far as Irkutsk, it will assume far greater proportions.

CHAPTER XIV.

Water and overland communication.

The transport of goods between European Russia and Siberia by the Volga and Obi; the Obi-Yenisei canal; navigation in Western Siberia; navigation on the Yenisei and Angara; steam navigation on the Baikal; navigation on the Lena and the Amour basin; steamer communication with the Siberian ports of the Northern and Eastern oceans; the Volunteer Fleet; a cursory view of the overland communications.

THE wide expanse and sparse population of Siberia combined with that historical destiny which has been described in the commencement of the present work, have prevented its being enriched with regular overland means of communication which could have been accomplished at the expense of a vast amount of labour and capital. Nature has, on the other hand, richly endowed this country with water communication; washed on the north and east by the waters of the Arctic and Pacific oceans, it is at the same time intersected for thousands of versts by large rivers connecting these oceans with western China, and in general with Central Asia. Thanks to these rivers, whose basins cover several million square versts, in summer time it is possible to communicate with far distant regions. This was the route taken by the conquerors of Siberia and the settlers who followed them. The Volga, Kama Chusovaya, Serebrianka, Tagil, Tura, Tobol, Irtish, Obi, and other rivers and comparatively short forest tracts this is the route followed by Ermak and by the traveller of the present day. This is however from the west, but of late years communication has been kept up with Siberia by sea from the north and from the east.

The hydrographic sketch of Siberia already given has shown how abundantly the country is supplied with water, but unfortunately the insufficiency of the coast development on the one hand, and the severe climate of the arctic zone on the other hand, prevent the sea navigation from reaching that degree of development which would be possible under more favourable conditions. This same severity of climate and the prolonged period during which the rivers are in consequence frozen over, considerably hinders navigation on the principal Siberian rivers which fall into the Arctic Ocean. Other circumstances, which will be mentioned hereafter also interfere with the progress of navigation on those rivers which flow into the Pacific.

The most important rivers of Siberia, the Obi, Yenisei and Lena, flow from south to north, and are for the greater part of their course navigable; only one river, the Amour, flows to the east, and, at the junction with the Sungara, turns northwards and falls into the Pacific Ocean.

The great Siberian river, the Obi, rises in Mongolia, carries vast masses of water into the Arctic Ocean and gathers along its extensive course a multitude of large and small rivers which fertilize and animate an expanse of more than $3^1/_2$ million square versts. With a total length of 5,300 versts it has a most extensive basin on which regular navigation is kept up over an extent of 15,000 versts. There is always a lively transport trade on the Obi system and the rivers composing it have a transit character, as there is but little local exchange of merchandise, all freights being transported from far distant regions. Being almost on the borders of Europe and Asia, the Obi and its tributaries form the cheapest means of communication between two vast continents of the world. Asia only supplies Europe with the raw products of the soil, the animal kingdom, the produce of the fishing and hunting trades which Europe then returns to her in a finished state. Before the opening of the Ural Railway these goods were conveyed in summer principally along the Kama and its tributaries, then carried by road across the Ural chain and then again by water on the rivers of the Obi system. The road is now replaced by the Ural and Samaro-Zlatooust railways, which deliver European goods to the Obi system through the Tura, Mias and other rivers; but the most important route before the opening of the Cheliabinsk section was the Ural line which delivers goods partly at Irbit and partly at Tumen. These goods, both from Irbit and Tumen are conveyed further into Siberia on the rivers Tura and Tobol up to the point where this latter falls into the Irtish. A considerable quantity of goods from the Krestovsky fair follow the route. Before reaching the mouth of the Tobol, part of the freight separates and goes down the Tavda and southern Sosva to supply the wants of the population of the settlements along these rivers as well as the Sosvinsk works and those of the Bogoslovsk mining district.

From the mouth of the Tobol the European freights are distributed in two directions: about 25 per cent goes towards the source of the Irtish and 75 per cent towards that of the Obi. The goods are conveyed along the Irtish principally to the following populated points: the towns of Tura, Omsk, Pavlodar and Semipalatinsk; those conveyed along the Obi are in a small part destined for the consumption of the strangers and fishmongers on the lower parts of that river, and the sparse population of the towns of Berezov and Obdorsk, whilst by far the greater part is sent up the Obi to supply the government of Tomsk and the whole of Eastern Siberia. The principal points of destination are Surgut, Narym, Barnaoul and Biisk, but the most important is Tomsk. Some of the goods are also shipped up the Chulim as far as the settlement of Berluze and the town of Achinsk.

The Siberian goods pass over the same route but in the contrary direction and here the lower parts of the Tura and Tobol form a most important part of the waterways of Siberia joining all the streams which convey Siberian merchandise to Russia in Europe. In the same way the Irtish and its tributaries are the most important part of the Obi basin and then the middle course of the Obi itself but not that portion of

it which is so abounding in water. The statistics of the quantity and character of the goods conveyed by the Ural Railway may therefore be taken to discribe the goods traffic on the Tura and Tobol; Tura, the terminus of the Ural line, situated on the river bearing that name, receives all the European goods sent to Siberia by water and also despatches freight by rail from Siberia to European Russia. The following table gives these statistics from the opening of the Ural Railway:

Date.	European goods received at Tura station, in pouds.	Date.	Siberian goods, despatched from Tura station, in pouds.
1886	985,000	1886	753,000
1887	1,243,000	1887	3,028,000
1888	1,428,000	1888	4,234,000
1889	1,504,000	1889	2,746,000
1890	1,713,000	1890	3,516,000
1891	2,302,000	1891	4,855,000

These figures show that the goods traffic from Siberia to European Russia is rapidly developing whilst that from European Russia to Siberia makes but very slow progress. This proves that Siberia is capable of producing far more that she requires, and that the opening of the Ural Railway was sufficient to draw goods from far distant places in the province of Semipalatinsk to European Russia. The principal freight which Tura receives by water and forwards by rail is grain; in 1891 the total amount of grain of various denominations transported was 3,930,805 pouds, or 80 per cent of the whole transport; this included 2,195,019 pouds of wheat, 571,778 pouds of rye, 345,555 pouds of oats, 48,365 of barley, 574,980 of rye flour, 145,835 pouds of wheat flour, et cetera; there were 1,151,913 pouds of this delivered at Ostrovskaya station and 1,081,995 at Ekaterinburg. Besides grain, 492,261 pouds of tea were despatched from the same station, of which 480,941 pouds were directed to Perm to be sent further on. Grain and tea therefore amount to more than 90 per cent of the Siberian goods. Siberia principally receives 364,000 pouds of sugar, 340,000 pouds of various naphtha products, 270,000 pouds of manufactured goods, about 100,000 pouds of iron and iron wares, 140,000, of tobacco, 36,000 pouds of candles, or about 63 per cent of the whole amount received.

The goods traffic along this main water way of the Tura and Tobol rivers has only of late years begun to assume a lively aspect. Before the opening of the Ural Railway the yearly transport did not exceed 2·5 million pouds, and it has now risen to 16 million pouds; in 1886 it amounted to 3 millions; in 1888, to 7 million, and in 1890, to 8 million pouds. This quantity of 16 million pouds forms 75 per cent of the whole goods traffic on all the waters of Western Siberia, as the total amount does not exceed 20 million pouds. The river Tura is the most important means of communication between Siberia and European Russia. It becomes navigable from Turinsk, but the briskest traffic is from Tiumen to the mouth of the river, a distance of 169 versts. The Tobol is navigable for about 600 versts, but the only part of it

which is of much importance is from the mouth of the Tura to the junction of the Tobol with the Irtish. The Irtish itself is navigable from its mouth to Semipalatinsk, a length of 2,620 versts; in its long course it intersects the fertile province of Semipalatinsk, the Kirghiz, Ishimsk and Barabinsk steppes, and fertilizes an enormous territory. This river conveys grain freights, salt, cattle and animal products to Tobolsk and Tiumen from even the far distant parts of the province of Semirechinsk. Steam navigation was started here in 1862.

Although the Obi is a very full stream from Samarov it flows through an almost uninhabited region, so that there is no regular service of steamers down its course. There is however a brisk traffic on the upper part of it as far as Barnaoul, a distance of about 2,000 versts, and sometimes as far as Biisk. The Obi is formed by the junction of the Bey and the Katuna, and its principal tributaries are on the right. The most important of these are the Tom which waters the rich district of Kuznetsk and the Chulym which is navigable although with difficulty as far as Achinsk, a distance of 1,000 versts. The river Ket has also a considerable commercial importance as a connecting link between the basins of the Obi and Yenisei, through the Obi-Yenisei canal, now in course of construction. Steamers can go up the Ket as far as the settlement of Makovsk.

The above mentioned Obi-Yenisei canal is to connect the Ket, a tributary of the Obi, with the Kass, a tributary of the Yenisei. The idea of connecting the basins of the Obi and Yenisei originated a hundred years ago when a scheme was presented to the Emperor Paul for joining these system by the Tym, a tributary of the Obi, and the Sym, a tributary of the Yenisei. Schemes were next proposed for joining the Ket with the Kem, a tributary of the Yenisei and the Vakh, a tributary of the Obi, with the Elagona, a tributary of the Yenisei, but none of these projects were realized. Considerably later, in 1875, the new idea of joining the Ket with the Great Kass sprang up. A Siberian merchant, Funtusov, at his own initiative and expense investigated the ground between these two rivers, and finding that the scheme was feasible, drew the attention of the Government to this subject. The engineers who were sent over to study the question found that it was quite possible to carry out the work and it was therefore resolved to commence the undertaking. The river Ozernaya falls into the Ket at a distance of 550 versts from its mouth. The river Lomovataya flows into the Ozernaya and is connected with the river Yazevaya which flows out of the lake Bolshoi. The little Kass rises in the vicinity of this lake and falls into the big Kass which forms part of the Yenisei system. The river Ozernaya forms part of the canal $14^1/_2$ versts from its mouth. The canal then follows the Lomovataya for $47^1/_2$ versts and the Yazevaya for $31^3/_4$ versts up to lake Bolshoi. From this point a canal has been excavated $7^1/_2$ versts long and 6 fathoms wide at the bottom, which enters the little Kass and follows it for a distance of 89 versts to the point where the big Kass commences at a distance of 192 versts from the Yenisei. The navigable Angara joins the Yenisei near the mouth of the big Kass and flows from lake Baikal on the shore of which Irkutsk is situated. The Obi-Yenisei canal will therefore open up an enormous water way of 5,000 versts, connecting Tiumen with Irkutsk and intersecting the whole of Western Siberia. This work was commenced at the expense of the Government in 1882 and is being carried on very energetically; a great deal has been done, and there is every hope that the undertaking will shortly be brought to a successful termination. In

connection with this, much dredging has been done in order to deepen and clear the connecting streams, so that the result will most likely be eminently satisfactory.

Thanks to the abundance of water in the rivers of the Obi system, there is a large number of steamers plying on them, belonging to private owners and companies, and in ome places, even a regular service is kept up. The success and progress of the Obi steam savigation is due to the Government, which always granted assistance to private initiative whenever it was in the interests of the public.

The first steamer in Western Siberia belonged to Poklevski and made its appearance on the Obi in 1843; in 1854 there were 3; in 1860, 10; in 1870, 20; in 1875, 32; in 1880, 37; in 1885, 57; in 1887, 60; in 1889, 64; in 1890, 65; in 1891, 69; in 1892, 90; and in the present year there are 102 steamers and 200 barges. Most of the steamers do not exceed 100 nominal horse power and at present the fleet of Western Siberia consists of the following boats:

1	steamer	of	250	nominal	horse	power.
1	»	»	180	»	»	»
4	»	»	150	»	»	»
8	»	»	120	»	»	»
9	»	»	100	»	»	»
18	»	»	80	»	»	»
11	»	»	60	»	»	»
15	»	»	40	»	»	»
21	small steamers.					

The principal traffic, as already stated, is between the sources of the Bey and the Katuna on the one hand, and that of the Irtish on the other hand, as far as the mouths of the Tura and Tobol, the freights being conveyed the enormous distances of 2 to 3 thousand versts. The question of rates for such long journeys is of great interest. Notwithstanding the great progress made in steam navigation and the competition between shipowners, freights on the Obi basin are very high; for 3,000 versts the charge is 25 kopecks per poud, that is $^1/_{120}$ kopeck per poud-verst, whilst on the Volga for long distances the boats eagerly take $^1/_{600}$ kopeck and even $^1/_{700}$ kopeck per poud-verst. This is due to the insecurity of the navigation in consequence of the great risks in running the steamers without the requisite auxiliary measures. Scanty and incomplete information concerning the opening and freezing of the rivers, insufficient telegraphic communication to give warning of an unexpected ice blockade, the small number of inhabited points along the principal rivers, and other circumstances, are the means of causing frequent disasters.

The measures lately taken by the Government for improving the water system of Western Siberia, which serves as a feeding branch for the Great Siberian Railway, will doubtless have the effect of lowering the rates; and the surplus grain, accumulated in the Tomsk, Semipalatinsk and Semirechinsk districts, will not only find an advantageous outlet in the distant parts of Siberia, but will approach St. Petersburg by water and eventually find its way abroad.

Some of the most important of these measures are: that dredging will be carried on along the bottom of the river Tura between its mouth and Tiumen, along the Tobol from the mouths of the Tura till it falls into the Irtish, along the river Tom from Kuznetsk to its mouth and along the river Chulym from Achinsk to its mouth. On a considerable portion of the Obi system difficult places for navigation will be marked and observations of the water level will be taken which will be telegraphed to the places where the vessels usually resort. A telegraph wire will be laid from Tobolsk to Samarov and from Samarov to Krivoschekov, a distance of 2,245 versts. In order to carry on these operations the necessary dredging and earth removing machinery, 5 steamers and 3 steam long-boats will be amongst other things provided by the Government.

The river Yenisei, which rises in Mongolia, is navigable almost from the frontier to its mouth. For a long time however the rapids interfered with the progress of navigation, but it has lately been found possible to go round them. Steam navigation on the Yenisei really began in 1863 when traffic was opened between its mouth and Yeniseisk. Five years later a Dutch company offered to establish a regular steamboat service on the Angara to Baikal and to clear away the rapids, but the offer was not accepted. In 1888 the number of steamers rose to 4 and the total amount of freight conveyed was 129,000 pouds. In 1890 there were 6 steamers, 30 barges and about 20 large boats plying between Yeniseisk and Karaoul transporting 260,000 pouds of merchandise. Regular steamboat service on the Yenisei is kept up, on the one side, between Yeniseisk and Krasnoyarsk, and on the other, between Krasnoyarsk and Minusinsk. A similar service between Yeniseisk and the mouth of the river could not be established, partly on account of insufficiency of freights, and partly on account of the rapids.

At present, in order to convey building materials for the Great Siberian Railway by sea through the mouth of the Yenisei, the Government has found it expedient to investigate this route, the gulf of Yenisei and the river itself. For this purpose two steamers have been ordered, specially designed for cruising on the Yenisei, and in 1893 an expedition will be fitted out and despatched to the estuary of the river. Both of these steamers were ordered in England at Dumbarton and were to be ready July 1st, this year. One of them has a twin screw, is of 500 horse power and draws 8 feet of water; it is destined for service between the mouths of the Yenisei and the town of Yeniseisk and calculated to carry 93,000 pouds; the other is a paddle steamer with a draught of $3^1/_2$ feet; it is intended to tow barges up to 60,000 pouds weight between Yeniseisk and Krasnoyarsk. In this way the whole journey from the mouths of the Yenisei to Krasnoyarsk can be effected without unloading, by simply changing the barges in tow from one steamer to the other.

From Yeniseisk the navigation takes another direction, along the river Angara which is a tributary of the Yenisei. It flows from lake Baikal through a distance of 1,705 versts and joins the Yenisei at Yeniseisk. For a distance of 600 versts from Irkutsk to the prison of Bratsk, the Angara is quite navigable but the remainder of its course of more than a thousand versts is full of rapids and interferes with regular navigation. However, Sibiryakov thought it worth his while in 1885 to solicit a five-years license from the Government for running steamers on this part of the river, binding himself within the space of two years to organize

a service of tug and cable boats for carrying goods, passengers and mails by at least two steamers. Sibiryakov's endeavours to institute cable steamers on the Angara may be called unsuccessful; in the middle of 1888 he started a caravan of two steamers and 3 barges with a load of 30,000 pouds of grain up the Angara. By August 15th the caravan had only travelled 400 versts and on account of the shallow water had to stop at 500 versts from its destination, the mouth of the Ilim, and turn back after having sustained considerable damage. Regular steamboat service on the Angara between Irkutsk and Yeniseisk is therefore a thing of the future, but as the Great Siberian Railway will intersect both the Yenisei and the Angara, these two rivers will serve to feed it and deliver goods both from above and below. Further on, at Verkhneoudinsk, the line will intersect the large river Selenga which rises in China and is within a distance of 1,000 versts from the Chinese Yellow river. Here steamers are plying and the railway can not only be supplied with freights coming from lake Baikal by water, but even with goods from the borders of China.

The third large Siberian river, the Lena, occupies a more independent position and is neither connected with the Amour basin, nor with that of the Yenisei. The basin of the Lena does not directly come in contact with the Great Siberian Railway but will in all probability have a considerable influence indirectly in delivering goods from the Yakutsk region. There is at present steam navigation on the Lena, but it is more or less of a casual nature. Vessels from Europe have repeatedly visited the estuary of this river but the trade was of less importance than that done at the mouth of the Yenisei. The Government, being anxious to encourage intercourse between Europe and the Siberian shores of the Arctic Ocean, has several times granted by an Imperial decree a free import of goods through the mouths of the Obi, Yenisei and Lena to various individuals, including foreigners. The final term of this privilege expires next year, in 1894.

The Kiakhta Steamboat Company, founded in 1881 by the local merchants, keeps a regular steamboat service on lake Baikal in accordance with the Government regulations of May 1, 1890, referring to mail-passenger and steam tug service on lake Baikal. These regulations require that the company should employ the two steamboats it possesses for the following work: 1. three journeys a week from the Listvenich settlement to Mysovsk pier, a distance of 80 versts across the lake from west to east and back; 2. five journeys to and fro per season from the Listvenich settlement to the Tourkinsk mineral water springs, the mouth of the Bargouzin, Krougoulin, Sosnovka and the mouth of the Upper Angara, a distance of 700 versts. These latter journeys were fixed in accordance with the local requirements and subject to the approval of the Governor-General of Irkutsk; the service is in general carried on according to a time-table edited by the company, upon agreement with the local authorities, and confirmed by the chief of the district. For keeping up the above mentioned service the company receives the following Government subsidies: 1. for the journeys between Listvenich and Mysovsk, 296 roubles for every double journey there and back; 2. for every cruise from Listvenich to the mouth of the Upper Angara, 2,170 roubles; counting 78 of the first and 5 of the second journeys per season, the total subsidy amounts to 33,938 roubles, and should not exceed this sum. The concession has been granted to the company for a term of 12 years commencing from 1890.

This concludes the discription of the navigation on the Siberian waters feeding the Arctic Ocean, as the basin of the fourth Siberian river, the Amour, and the lake Khank which is in connection with it, appertains entirely to the Eastern Ocean.

Navigation on the Amour basin.

The navigation on the Amour basin is a matter of comparatively recent date; as lately as 1840 it was not known whether the rivers of this basin were navigable, and very little was known of the Amour itself and its estuary. In 1844 for the first time an Imperial edict was issued, empowering the Russian-American Company to fit out a vessel at the expense of the Government for exploring the estuary of the Amour. On May 5, 1846, the ship «Constantine», under the command of Gavrilov, entered the Amour, and this was the first vessel that had ever made its appearance on the waters of that river. From that time the exploration of the country went with more rapid strides, and later, thanks to the military expedition of Count Mouraviev, who in 1854 descended the Amour with the Government steamer «Argun», built at the Shilkinsk works, Russian rule in the Amour region obtained a firm foothold. The formal annexation of the extensive basin of the Amour to the Russian dominions later on may be regarded as the commencement of the civil developement of that region. In 1855 Vice-Admiral Poutiatin went up the Amour in the steamer «Nadezhda» and in the following year another steamer, the «Shilka» made its appearance. At the end of 1856 an Imperial edict was issued concerning the organization of the Amour province which included Kamchatka, the whole of the shore of the Okhotsk Sea with the region of Udsk and the places occupied by Russia in the low country of the Amour and the Straits of Tartary. In order to keep up regular intercourse between the different points of the new territory the Government acquired two more steamers, the «Amour» and «Lena». Thus in 1857 there were 5 Government steamers plying on the Amour; in 1860 the number was increased to 8, and in 1870 it rose to 12. At the same time private individuals and separate Government institutions also began to provide themselves with steamers; the first private steamboat on the Amour made its appearance in 1859; the telegraph department in 1868 possessed 5 steamers and the Engineering Department 3, so that in 1870 there were altogether 25 steamboats on the Amour.

About this time the idea originated of instituting a regular steamboat time service on the Amour in order to satisfy the increasing wants of trade and in case of necessity for moving troops and carrying Government stores and forage. For this purpose, at the end of the year 1871, a 20-years concession was granted to Benardaki and Co. for keeping up a regular steamboat communication on the rivers of the Amour basin. Benardaki then formed the company for organizing regular steamboat traffic on these rivers. The company took upon itself the obligation of maintaining from 1872 regular mail and passenger traffic on the Amour between Nikolaevsk and Sretensk, a distance of 2,956 versts, also a mail steam tug service from Khabarovka to post № 4 near lake Khanka, a distance of 630 versts, on lake Khanka as far as the post of Kamen-Rybolov, 135 versts, and an occasional steam tug service from Sretensk to Nicolaevsk.

The number of steamers was not to be less than 12, and when the company was started the Government made over to it 9 steamers which belonged to the Naval Department. The passenger and goods freights were fixed by a special tariff and the Government besides guaranteeing a fixed amount of Government freights also agreed to pay a subsidy during the whole stipulated period of 20 years in the shape of a payment of 2 roubles 15 kopecks for every verst of each voyage on the rivers Shilka, Amour, Ussuri and lake Khanka during the first 10 years with a reduction of 5 per cent per annum during the next 10 years. The highest limit of this scale was fixed at 245,000 roubles a year. Without dwelling upon the other details of the agreement between the Government and the Amour Steamboat Company, it may be mentioned that the latter pledged itself to erect engineering workshops at Khabarovka for repairing the Government steamers, and to provide its own boats with the necessary means for executing small repairs.

Thanks to the institution of regular steam navigation on the Amour basin, the intercourse between the various points of Eastern Siberia became so animated that private individuals were able to start their own steamers and barges without Government assistance. Fifteen years after the formation of the Amour Steamship Company, in 1885, there were 44 steamers owned by various individuals and companies cruising on the waters of the Amour basin as seen below:

1. The Amour Steamship Company possessed 17 steamers of 1,107 aggregate horse power, and also 18 iron and 8 wooden barges, carrying altogether 161,000 pouds.
2. The merchant Pakholkov possessed 2 steamers of 120 horse power and 2 barges.
3. The Hamburg merchant Dickman owned 5 steamers of 265 total horse power and 4 barges.
4. The Kiakhta Company owned 2 steamers of 180 total horse power and 3 barges.
5. The mercant Loukine was running 3 steamers of 190 total horse power.
6. The merchant Boutine owned 5 steamers of 205 total horse power and 6 barges carrying altogether 57,000 pouds.
7. The Upper Amour Gold-digging Company had 2 steamers of 160 total horse power.
8. The Telegraph Department was running one steamer of 15 horse power.
9. The Engineering Department owned one steamer of 40 horse power.
10. The Zeisk Company owned 3 steamers with an aggregate of 267 horse power.
11. The Nieman Company owned one steamboat of 12 horse power.
12. The merchant Etkine was running 2 steamers of 80 total horse power.

Of all the above mentioned shipowners only the Amour Steamship Company and the Kiakhta Steamboat Company received assistance from the Government; the former during the 20 years of the original concession received 245,000 roubles mileage and 75,000 roubles guarantee for carrying Government freights, altogether 258,750 roubles; and after the expiration of this concession, in 1891. a temporary agreement was made with the company insuring it a yearly Government subsidy of 183,000 roubles until the present year 1893. The latter company receives a mileage in the same proportion, amounting to 33,938 roubles per annum, for regular steam service on lake Baikal and the passenger and goods freights have been fixed at a rather high tariff. For instance, the charge for conveying tea, furs and manufactured goods between

the settlement of Listvenich and the Boyarsk pier, a distance of 10 versts, is 1/8 kopeck per poud-verst; and from Listvenich to the mouth of Angara, a distance of 700 versts, there is a reduction of 40 per cent from this poud-verst charge.

When first started, the Amour Steamboat Company was hardly prepared to execute the obligations it had taken upon itself; not possessing capital, it was obliged to have recourse to foreign loans, and the percentages on the sinking fund of the debt swallowed up a considerable portion of the revenue, so that, notwithstanding repeated assistance from the Government in the shape of loans, the company was unable to keep its steamers in proper repair. In consequence of this, when the contract expired in 1892 there was a question of entrusting the steam service on the Amour basin to other parties. An offer was made by Messrs. Sibiriakov and Shevelev who were willing to undertake the business on more advantageous terms than the Amour Steamboat Company. In making a new contract it was expedient to stipulate that the old steamers should be replaced by new ones. In consequence however of the delay in concluding the contract, the new promotors were unable to change the old steamers at once and therefore the Government allowed the business to remain two years longer in the hands of the Amour Company, especially as they agreed to the same terms as the new contractors. The principal conditions were as follows: the contractors undertake to keep up a regular steam service on the Amour, Ussuri, Shilka river and lake Khanka for the space of 15 years with a Government subsidy in the form of a payment of 1 rouble 50 kopecks per verst for every verst actually made on these waters during the firsts 10 years, with a reduction of 5 per cent per annum for the succeeding 5 years, this mileage not to exceed 183,532 roubles per annum during the first 10 years. Besides this the Government does not bind itself to provide cargoes or to make extra payments for them.

Next year, therefore in 1894, the new steamers of Sibiriakov and Shevelev will make their appearance on the waters of the Amour basin; their contract expires in 1908. At present the Government is examining the request of these contractors to turn the Amour Steamboat enterprise into a joint-stock company with a capital of one million roubles.

The organization of regular and constant steam service between the coast stations of the far distant Russian domains on the shores of the Pacific has always engrossed the attention of the Government as it would provide a convenient and cheap sea route for the local population. In the complete absence of roads in that region, steamboat communication acquires particular importance as being the only means of intercourse between the above mentioned points. The efforts made in this direction would also excercise a beneficial result upon Russian commercial intercourse with Corea, Japan and China and benefit the economical position of the country. Whilst up to 1880 the existing means of transport were not only insufficient to secure regular communication for the inhabitants but did not even suffice for the wants of the administrative establishments for the transport of Government stores and passengers. For these reasons the Government has repeatedly taken measures for facilitating sea communication between the Pacific ports of Siberia on the one hand, and between these ports and the principal ports of Japan and China on the other, but regular communication has been effected only since 1881, when the matter was undertaken by Mr. Shevelev. This gentleman bound himself to keep up a time service between Vladivostok and Nicolaevsk and

between Vladivostok and Han-Kow, touching at Shankhai, Nagasaki, the gulf of St. Olga, the Korsakovsk post, the Imperial harbour, post Doue and the gulf of De Castri; besides freights according to a fixed tariff, the contractor receives from the Government a mileage of 3 roubles during the first 10 years, with 10 per cent reduction per annum, for the next 5 years.

The voyages abroad were instituted in the interests of commerce to maintain intercourse with the countries lying to the south of the Russian dominions. In consequence however of the evident urgent necessity of increasing the communication between the Russian ports, Mr. Shevelev's steamer «Baikal» was in 1886 exclusively employed in cruising about the gulf of Tartary, accomplishing six journeys to Nicolaevsk to the detriment of the foreign trade. Besides this steamer, two other vessels of the Siberian flotilla and one steamer belonging to the Naval Department were employed in carrying goods and passengers through the Straits of Tartary. Some of the above mentioned Pacific ports, such as Doue, the Korsakovsk post, and others, are also visited by the vessels of the Volunteer Fleet; nevertheless the means of transport available, about 1885, did not suffice for the increasing wants of the Siberian Pacific region and it was necessary to have recourse to the foreign vessels which brought goods from Western Europe and the United States to the Siberian ports.

It was naturally undesirable that foreign vessels should take part in the coasting trade in Russian waters along the shores of Eastern Siberia, and therefore the question arose of increasing the steamboat service in the Far East. Upon due consideration it was deemed most advisable to allow Mr. Shevelev to institute some supplementary communication between the ports of the Pacific, and a contract was concluded with him for 15 years from September 17, 1888. Mr. Shevelev bound himself to keep up three lines of regular steamers: 1. through the Straits of Tartary between Vladivostok and Nicolaevsk; 2. between Vladivostok and Shankhai; 3. in the gulf of Peter the Great, touching at certain points along the line. The passenger and goods freights were charged in accordance with a fixed tariff, and besides this, in order to encourage the enterprise, the contractor receives from the Government a mileage at the rate of three roubles paper for every mile during the first 10 years with a gradual yearly reduction of 10 per cent per annum for the remaining 5 years. This mileage during the first two years was not to exceed the sum due for a distance of 37,000 miles, and for 50,000 miles for the following years. According to the terms of this contract Shevelev is at present running steamers between the above mentioned ports of the maritime district and also to Han-Kow, Nagasaki and Shankhai.

There is no regular service of steamers to the other ports of the Arctic and Pacific. But even the establishment of a casual steam service between the European ports and the ports of Siberia on the Northern and Eastern Oceans has a most important influence upon the industrial development of the country.

The determination of a northern route from Europe through the White Sea and the Kara Straits with the mouths of the Obi, Yenisei and Lena has been briefly described at the commencement of this article and it now only remains to add some supplementary information on this subject. Thanks to the autority of Count Litke, the academecian Bere and other northern explorers, who did not admit of the possibility of penetrating from Europe into Asia

through the Arctic Ocean, the northern sea route to Siberia was regarded as an unattainable vision, and M. K. Sidorov did great service when, in 1853, he was the first to prove the erroneousness of the opinions of Count Litke and Mr. Bere; unfortunately however he did not succeed in awakening the sympathy of any of the scientific societies. He based his arguments upon the constant intercourse between the inhabitants of the coast from the mouths of the Pechora and Obi, but nevertheless, such a strong conviction prevailed that it was impossible to reach the Kara Sea, that the promise made by Sidorov of a large reward to the first vessel which would enter the Yenisei and bring back a cargo of graphite, was not sufficient to tempt anybody. In 1862 he succeeded in persuading Kruzenstern to undertake an expedition to the east, and although it did not terminate successfully, still it convinced those who took part in it that the Kara Sea was almost free of ice. However no more adventures were found after Kruzenstern, so Sidorov was obliged himself to take the initiative and determined to fit out a polar expedition at his own expense, but not finding any of his own countrymen desirous of joining him, he went to Sweden where he made the acquaintance of Baron Nordenskjöld. Next a lively correspondence was entered into between them, Nordenskjöld becoming ever more and more interested in Sidorov's ideas about a sea route to Siberia.

In 1869 Sidorov sailed on the steamer «Georgi» from Cronstadt, but near the mouths of the Pechora let slip the favourable time while saving the English steamer «Norfolk». Resolutely propagating his idea, Sidorov applied to the well known geographer Petermann to print in his celebrated Mittheilungen an appeal to those desirous of accepting his offer, namely a reward of 2,000 pounds sterling to him who should first make the sea passage from Europe to the estuary of the Yenisei. Thanks to the wide circulation of Petermann's magazine, Sidorov's appeal attracted the attention of the Englishman Wiggins who loaded the steamer «Diana» for this expedition. In 1874, he successfully passed through the Kara Sea and entered the mouths of the Obi and Yenisei, after which he returned to England having practically demonstrated the possibility of a north sea passage to Siberia. In 1875 the Swedish merchant Dickson fitted out the yacht «Experiment» under the command of Baron Nordenskjöld, which also successfully reached the estuary of the Yenisei. The vessel made the return passage, while the Captain, ascending the Yenisei in a boat to Yeniseisk, went back by land. In the following year Baron Nordenskjöld on the steamer «Himer», and Wiggins on the steamer «Famela» once more safely sailed through into the estuary of the Yenisei.

The late Sidorov having thus obtained the confirmation of the justice of his idea did not himself however for a long time have the chance of making the passage. Only in 1876 did he succeed in fitting out the vessel «Northern Light» under the command of Schwanenberg, which unfortunately suffered shipwreck among the Little Bregovsk Islands. In 1877 another vessel belonging to Sidorov, built in Yeniseisk, the «Dawn» under the command of the same Schwanenberg, sailed from the estuary of the Yenisei and safely arrived in St. Petersburgh. In the same year Trapeznikov's steamer the «Louisa» sailing from Hull, on the 18th of July passed through the Kara Straits without mishap, and having entered the mouth of the Obi penetrated by the Irtysh to Tobolsk, with a cargo of iron and olive oil. At the same time Sibiriakov chartered the steamer «Frazer» in Bremen, which landed safely on the 21st of August at the mouth of the Yenisei a cargo of tobacco, sugar, machinery, et cetera. In 1878 the «Fra-

zer» repeated her voyage with the same success. At the same time Baron Nordenskjöld's second expedition took place. This navigator in the steamer «Vega» made the voyage from Transen through the whole Arctic Ocean and returned to Europe after circumnavigating the continent of Europe-Asia.

Sabsequently there were not a few other successful expeditions of this kind. In the same year, 1878, two large European steamers entered the mouth of the Obi with colonial wares and iron goods, in exchange for which they took cargoes of wheat and hemp. Knop's steamers the «Tsaritsa» and the «Moscow» entered the mouth of the Yenisei, the latter reaching Yeniseisk. Nordenskjöld's steamer the «Lena» entered the mouth of the river of the same name and ascended as far as Yakutsk having thus sailed 2,700 versts from the mouth.

In consequence of such results, sea communication between Europe and Siberia by the Arctic Ocean appeared to be completely established, although there were still not a few accidents to ships attempting to make their way to Siberia by this new route. In 1887 in Newcastle a company was formed for establishing commercial relations with Siberia, and with this object it equipped the steamer «Phoenix» which successfully reached Yeniseisk. This first expedition, in consequence of the unfortunate choice of goods, was in a commercial sense a failure for the company, but nevertheless the latter having become more nearly acquainted through its agents with the needs of Siberia and its productions, fitted out in the following year the steamer «Labrador», which was to carry its cargo to the mouth of the Yenisei and there receive Siberian goods from the «Phoenix». But neither of these steamers attained its object and the company incurred considerable losses and soon wound up its affairs. The ill success of this company did not however quell the desire of the enterprising Englishmen to again try their luck, and with this object once more an Anglo-Siberian Company was formed, which despatched a steamer to the mouth of the Yenisei with a cargo of assorted goods. In consequence of an accidental concurrence of various unfortunate circumstances, notwithstanding even the granting of the right of duty-free importation of goods into the northern ports of Siberia during five years, the new company also had no success in a commercial sense and was obliged to wind up its affairs.

Thus, the result of these attempts was the positive establishment of the fact of the possibility without extraordinary difficulty of sea communication between Europe and Asia via the Arctic Ocean. But the commercial advantage of the employment of this route remains so far a thing of the future. In conclusion it is not out of place to remark in connexion with the north sea passage to Siberia, that Sidorov first pointed out the importance of stoking steamers for polar expeditions with pertroleum and in 1872 inaugurated this system in Archangel, intending to employ the liquid fuel of local origin, but the expedition then planned by him, as was mentioned, did not take place.

The Pacific coast of Siberia did not present any difficulties in the way of regular sea communication, but here this undertaking could not be developed in consequence of quite different causes. Till the end of the seventies the communication between European Russia and Siberia through the Pacific Ocean had a more or less accidental character. The establishment of steam communication with the Far East, undertaken in 1870 by the Russian Steam Navigation and Trade Company, did not possess any serious commercial importance. This undertaking

also assumed large dimensions only from the moment when the Volunteer Fleet established regular communication between Odessa and Vladivostok, calling at several Chinese ports on the way. This institution, called into existence in 1878 during the last Eastern war with the object of performing the duty of cruisers in war time and having commercial objects in time of peace, certainly gave a great impulse to the connecting of European Russia with the Far East, and strengthened the influence of Russia in the waters of the Pacific Ocean.

The Volunteer Fleet, whose ships are completely adapted to long ocean voyages, is every year increasing its activity in the conveyance of passengers and goods from the ports of the Black Sea to Vladivostok and Nikolaevsk. The number of persons carried hardly reaching 1,300 in 1882, in 1892 rose to 7,000, while the quantity of cargo for the same period rose from 4,800 to 780,000 pouds. This is, in no small degree, due to the comparatively low freights for a distance of over 10,000 English miles, a voyage taking about 40 days. The cabin passenger pays 500 roubles, including food for the voyage from Odessa to Vladivostok; the deck passenger, 100 roubles for the same distance, also with food. Cargo is charged 30 to 40 kopecks a poud.

Now the Volunteer Fleet disposes of nine steamers, with a total tonnage of 30,000 tons, and nevertheless it barely satisfies the demands made upon it. Thanks to its activity, Eastern Siberia now receives a mass of necessary articles from European Russia and not from abroad, and European Russia gets Chinese tea much cheaper than by land.

The survey of the land communications must necessarily be short. In virtue of historically constituted circumstances but one road passes through Siberia, at all deserving attention, this being the so-called Great Siberian Tract, joining Moscow with Irkutsk, or more exactly with Kiakhta, as over it more than anything else are transported the teas going from China through Kiakhta. Within the actual limits of Siberia it commences at Tiumen and passes through Yalutorovsk, Ishim, Tiukalinsk, Kainsk, Kolyvan, Tomsk, Mariinsk, Achinsk, Krasnoyarsk, Nizhneoudinsk. In this direction also took place the principal colonization of Siberia. Hence one road goes to Kiakhta and continues further into the Celestial Empire, while another goes to Baikal, upon which in summer there is steam communication, and in winter by sledge. There is also a road round Baikal passing through an extremely irregular country. Further on, the post road from Verkneoudinsk to Sretensk traverses very difficult places, where sometimes no snow whatever falls, in consequence of which in winter the driver is not seldom obliged here to carry his sledge on a cart, or on the other hand to put the cart on runners. The thinness of the population in the country along this road, inhabited mainly by vagrants, makes the conveyance of freights extremely difficult and expensive. From this point to Khabarovka the road follows the Amour, but few make any use of it. In summer, people prefer to take advantage of the water communication, in winter they travel in sledges over the ice, and only the break-up of the ice or some other hard necessity, forces them to turn to the natural earth road. The further communication with the terminal points of Siberia, Nikolaevsk and Vladivostok, is carried on in summer by water and in winter on the ice. In autumn and spring almost all communication is stopped here.

From the route just mentioned, especially from the Great Siberian Tract, at various points branch lesser tracts serving as feeders, but not one of them is distinguished by the

necessary good organization, nor possesses any great commercial importance. In the latter respect, a certain interest is presented by two routes leading from Western Siberia through the Altai into Mongolia. Of these the Chuisk tract, serving as the chief artery for the commercial traffic between Western Siberia and Mongolia, proceeds from Biisk by the valley of the river Chuya near the Imperial frontier to Kobdo and Ulyasutai, and for a distance of 240 versts, from Biisk to Angoudai, offers a pretty fair carriage road, while beyond this point to Kosh-Agach, 220 versts, it is only available for the passage of beasts of burden. The second or Bukhtarminsk tract, also terminating at Kobdo, leads from the territory of Semipalatinsk through the Bukhtarminsk camp, the Ulan-Daba pass and Khongo. This road from Ust-Kamennogorsk to the settlement of Urylsk, a distance of 382 versts, is available for wheeled traffic, its continuation being a mere track for pack-animals.

CHAPTER XV.

The Great Siberian Railway.

Historical review of the question of a Siberian railway; first proposals in reference to the construction of the road; the northern, middle and southern directions; the proposals of the engineers Ostrovsky and Sidensner; position of the question in 1890; commencement of the line at Vladivostok; position of the railway works on the 10th of March, 1893.

AFTER the annexation of the extensive Amour and Littoral territories and of the Ussuri region, the want was felt of good ways of communication, on the one hand in order to keep possession of them, and on the other, in order to attract settlers and form new centres of population. In consequence of this a series of schemes appeared for the construction of new roads in Siberia, and Count Mouraviev-Amourski himself was almost the first who conceived the idea of a railway in this country. Upon the occupation of the mouths of the Amour in 1850, and especially after the successful expeditions of Count Mouraviev himself down that river, the inconveniences of the estuary for the entry into the river began to become evident, and accordingly there arose the idea of making use of the splendid bay of De Castri in the Tartar Straits and of uniting it with Sofiisk on the Amour by a carriage road with the intention of subsequently converting it into a railway. The surveys in this locality and the scheme for such a road were carried out in 1857 by Colonel Romanov, but the road itself was not destined to be realized for want of means. Simultaneously with this appeared the proposal of the English engineer Dull. He conceived the idea of carrying a horse tramway from Nizhni-Novgorod through Kazan and Perm to one of the Siberian ports of the Pacific Ocean, but this scheme, unsupported by any estimates, was obviously of too unsubstantial a character, and the Government accordingly passed it over in silence.

In the same year another foreigner, the American citizen Collins, petitioned the Government to authorize him to found a stock-company, to be styled the Amour Railway Company, to unite Irkutsk and Chita. For the realization of this enterprise Collins wished to issue shares of 100 roubles calculating upon getting all the necessary capital subscribed in Siberia itself. This scheme, although likewise destitute of any solid foundation, thanks to the sympathetic attitude of the then Governor-General Count Mouraviev, was examined on the very shortest notice both in the Ministry of Ways of Communication and in the Siberian Com-

mittee, but in both institutions, albeit on different grounds, it was found to be inopportune and was rejected.

The third proposal following close upon the second in 1858 aimed at uniting by rail Moscow and the Tartar Straits on the Pacific shore of Siberia. The authors of this scheme were the Englishmen, Morrison, Horn and Sleigh, who without demanding any guarantee of income from the Government yet petitioned for such considerable privileges, that their granting would have lead to the concentration of the whole Siberian trade and industry in the hands of foreigners for a very long period. At the same time they gave the Government no guarantee for the timely and successful accomplishment of the work contemplated. On more intimate acquaintance with the said proposal it appeared that it was founded upon no preliminary surveys. On this ground the Government did not find it deserving of attention and informed the proposers of the scheme that the construction of a railway from Nizhni-Novgorod to the Tartar Bay did not enter into the plans of the Government and therefore could not be accepted.

The question of the Siberian railway aroused a lively interest in official and private circles, and therefore there was no lack of new, more or less imposing propositions. In the same year, 1858, appeared Sofronov's scheme, to carry a railway from Saratov through the Kirghiz steppes to Semipalatinsk, Minusinsk, Selenginsk, the Amour and Pekin. Against it there then appeared in print many objections in which was pointed out among other things the necessity of taking the line along the Great Siberian Tract, which had existed from time immemorial, crossing the Ural and connecting Nizhni-Novgorod with Kiakhta. Sofronov's scheme, like all the preceding ones, was a paper scheme and not the result of actual investigation of the trading and industrial needs of the localities, through which this mighty route was to pass. Submitted to Count Mouraviev-Amoursky's consideration, it called forth several corrections and additions, but had no practical consequences.

Of a much more practical character was the undertaking proposed by Kokorev and Co., who in 1862, having formed the idea of uniting the basins of the Volga and the Obi, these two giant streams of European Russia and Siberia, availed themselves of the scheme of the mining engineer Rashet, for a long time head of the Government and private mining works in the Ural, and perfectly acquainted with that district. The surveys carried out with reference to this scheme pointed to the following line, from Perm via the Nizhni-Tagil works to Tiumen, 678 versts with a branch to Irbit, 13 versts. This scheme, completely satisfying the demands of the through route, appeared to be the most desirable for the whole Ural mining industry, whose representatives received it very favourably. However, soon afterwards the same men abandoned the direction indicated by Rashet's schemes and adopted another proposed by Colonel Bogdanovich.

The latter's plan was one of the results of his despatch in 1866 to the government of Viatka to take measures against the injurious consequences of the crop failure which befell that country in 1864 After only two months from his departure from St. Petersburg, Bogdanovich reported by telegraph to the Minister of the Interior on the 23rd of March, 1866, as follows: «After removing all difficulties in the provisioning of the governments of Perm and Viatka and investigating the local conditions, I am of opinion that the only sure means of

preventing famine in the Ural country in the future is the building of a railway from the governments of the interior to Ekaterinburg and thence to Tiumen. Such a line, being subsequently continued through Siberia to the Chinese frontier would acquire a great importance both strategical and for international trade». Afterwards, on the receipt from Bogdanovich of a more detailed report on the subject, it was in April, 1868, thought good to authorize the said person to carry out detailed surveys and form a scheme for a railway from the village of Yershov through Ekaterinburg to Tiumen. The original project was somewhat hastily draughted and therefore the author subsequently had to make several corrections and additions in it.

The two schemes referred to, powerfully affecting the interests of different parts of Siberia, called into existence a third in 1869, that of the trader Liubimov. The latter carried out surveys from Perm through the towns of Kungur, Ekaterinburg and Shadrinsk to the hamlet of Bieloozersk, situated 49 versts to the north of Kurgan on the river Tobol, a distance of 711 versts. There was at the same time in view to carry from the main line a side mining branch in a northern direction from Ekaterinburg through the Nizhni-Tagil works to the Kushvinsk Government works, over a length of 131 versts.

The then Governor-General of Western Siberia, Adjutant General Khruschov also directed attention to the carrying out of these surveys closely affecting the country entrusted to his care, and having become acquainted on the spot with the direction of trade and its needs, presented at the end of 1869 a memorial addressed to the Emperor upon the necessity of the rapid solution of the question of the building of the Siberian railway, pointing out at the same time the nearest route for it through Nizhni-Novgorod to Kazan and Tiumen.

Thus at the end of the sixties, upon the question of the construction of a Siberian railway there were sharply defined the three above mentioned routes according to the schemes respectively of Rashet, Liubimov and Bogdanovich. All three begin at Perm, and they end, the first and third, in the town of Tiumen, and the second at Bieloozersk on the river Tobol, which it was proposed to make navigable. In the numerous discussions of these schmes in scientific societies and in literature, the first route was named the Northern, the second the Middle, and the third the Southern. Although no small number of preliminary surveys were made in all these directions, yet when in connection with the above mentioned report of Adjutant General Khruschov, this question began to be discussed in the higher Government spheres it was found possible in the first place to build only a part of the line projected, 700 versts in length, in order to join the Kama with the Tobol.

In order to form an opinion from the mass of not fully elaborated and not always exact data collected during the carrying out of private surveys, as well as to determine the most advantageous route for this line, a special commission was fitted out to the Ural, for whom the satisfaction of the needs of the Ural mining industry was to have the greatest weight, while at the same time it was pointed out to them that the road must, although to a slight extent, only answer to the requirements of the Siberian transit trade. However on a closer acquaintance with the matter it appeared that these objects are incompatible and therefore the preference was given to the Ural railway, the question of the Siberian road

remaining open for some time. The surveys afterwards carried out in 1872—1874 by the Government established three principal routes: 1. Kineshma, Viatka, Perm, Ekaterinburg, 933 versts; 2. Nizhni, Kazan, Krasnoufimsk, Ekaterinburg, 1,172 versts; 3. Alatyr, Ufa, Cheliabinsk, 1,173 versts. Thus, the first route proves to be a development of Mr. Rashet's scheme, that is, of the northern; the second, the altered scheme of Mr. Bogdanovich, or the southern; and finally the third, a compromise for the simultaneous satisfaction of the requirements of the Siberian and Central Asiatic transit traffic. The Committee of Ministers on examining these routes had its attention arrested mainly by the first two, and in 1875 it was decided to carry the Siberian railway by the route from Nizhni-Novgorod along the hilly bank of the Volga to Kazan, Ekaterinburg and Tiumen.

It will be appropriate to observe here that the choice of the direction for the Siberian railway between north and south everywhere called forth very lively discussions. Various pamphlets appeared arguing for and against the said routes, the constant subject of dispute being not the direction of the railway in the Siberian territory, but its direction within the limits of European Russia. From the above quoted enumeration of the routes it is clear that all the proposals agreed in this, that whencesoever the line of railway begin, it must necessarily pass through Tiumen. Further than this point few went, and few interested them selves whether the line led through the southern steppes and traversed cultivated centres or extended through the thickets of the north, while only passing through the most important places.

In consequence of such being the situation of a matter so deeply interesting to Siberia, the higher administrative authorities of the country more than once raised the question of the immediate laying down of railway communication between different very important points of the country. Thus already in 1875, a petition was started to build a railway from Vladivostok to lake Khanko, which was followed by a lively correspondence in higher Government spheres upon the construction of railways by preference in Eastern Siberia within the territory of the Littoral and the Ussuri region, especially in view of the development in all directions of China and Japan. However the then difficult position of the Imperial finances did not permit of immediately proceeding to the realization of such desirable propositions.

Continuing to discuss the most advantageous route for the Siberian line, the Government at the same time did not cease to occupy itself with the enlargement of the general system of railways, which in 1877 already reached Orenburg. In the following year, 1878, the Ural railway was opened, and in 1880 was completed the imposing structure of the Emperor Alexander II bridge across the Volga, while finally in the same year, ensued an Imperial command for the immediate building of the section of railway between Ekaterinburg and Tiumen. The accomplishment of the above named constructions in connexion with the results of new surveys showed that the southern route for the Siberian railway, sanctioned in 1875, on account of altered circumstances, could no longer answer to its destination. Accordingly in 1882 the discussion of the Siberian main line was begun afresh, which demanded the carrying out of supplementary surveys in several new directions, so that in 1884 the possibility appeared of presenting the three following routes instead of the southern. Of these, the first

was from Nizhni-Novgorod through Kazan, the Nikoloberezovsk wharf and Ekaterinburg to Tiumen, the second, from Samara via Ufa, Krasnoufimsk and Ekaterinburg to Tiumen, and the third, from Samara through Ufa, Zlatoust, to Cheliabinsk. The choice of one of these three directions would predetermine to a certain extent that of the main Siberian line itself, and at the same time to decide this question finally, without having sufficient data on the route which Siberian freights would take on the completion of the Ekaterinburg-Tiumen line then under construction, joining the basins of the Volga and the Obi, and also in consequence of the imminent completion of the Obi-Yenisei canal for the uniting of the basins of the Obi and Yenisei, did not seem possible. Really the realization of these two works was opening over a vast extent a water route connecting the basin of the Volga with lake Baikal, and consequently must have a serious influence upon the direction to be taken by the railway line right through Siberia. On the other hand arose the question, was there any necessity, with the existence of excellent water communication, for the immediate construction of an unbroken line of railway through the whole of Siberia, and was it not better to be content in the first instance with the building of isolated sections possessing some political strategical or industrial importance.

In this last respect the schemes put forth by the engineers Ostrovsky and Sidensner deserve particular attention. The former presented his proposal in the beginning of 1880; he maintained the idea that at that time, for the consolidation and economical development of Siberia and its relations with Russia, it was necessary above all things to improve and facilitate the internal communications of Siberia and only then complete the routes of transit then in existence upon this side of the Ural. Under the existing circumstances he saw no need for an unbroken line of railway right through Siberia. The author saw the solution of these problems merely in the quickest possible construction of the following three roads: Perm-Tobolsk, to unite the two large rivers Kama and Irtysh; Tomsk-Krasnoyarsk, to unite the Obi and the Yenisei, and finally the third, Omsk-Barnaoul, to unite the Irtysh at Omsk with the Obi at Barnaoul, with its continuation to Biisk, and further to the frontiers of China. On the creation of the two first lines, for an extent of 800 and 560 versts respectively, extensive communication is opened between the basin of the Volga and that of lake Baikal, this union being effected not with the aid of shallow and not always navigable rivers, but through the Kama and the Irtysh which never lack water.

The engineer Ostrovsky ascribed special importance to the Omsk-Barnaoul line. This line would shorten the great water road from the immensely rich mining district of Altai to Tobolsk and would strengthen the trade with China through Biisk, Kobdo and Ulyasutai. Only by taking advantage to the largest extent of the water ways of Siberia would be realized a cheap and convenient communication between the centre of Siberia, Irkutsk and the centre of European Russia, Moscow. The direct union by an unbroken line of railway of the two centres referred to will become urgent and realizable only in the more or less distant future, and beyond controversy only on Siberia attaining a higher degree of civilization than at present. Having examined the conditions which this imposing construction must satisfy, the engineer Ostrovsky indicates in general terms its direction from Moscow to Irkutsk as follows: «The road should pass through Riazan, Spassk, Ufa and thence through Zlatoust, Cheliaba, Petro-

pavlovsk, Omsk, Kainsk, Tomsk, Mariinsk, Achinsk, Krasnoyarsk, Kansk, Udinsk and Balagansk to Irkutsk. It will thus, throughout its whole extent, meet all the chief administrative and trading centres of Siberia, will nowhere quit the zone of densest population and will traverse almost exclusively the fertile chernoziom tract, from the Volga to the Yenisei. The constuction of the southern line might be accomplished in separate sections, each of which might be completed independently of the rest, preserving its own proper importance».

The route quoted of the Siberian railway indicated by the engineer Ostrovsky deserves attention in this respect that it almost exactly coincides with that which is now finally adopted for the Great Siberian Railway.

The engineer Sidensner, who took part in the expedition for carrying out the surveys in connection with the construction of the Obi-Yenisei canal, expressed the opinion that with the realization of this work and the removal of the rapids in the lower part of the Angara a vast water way would be opened of 5,000 versts extent, from Tiumen to Baikal. Next from Baikal begins the coast road to Sretensk of 950 versts; and there again, a new water way by the Amour for 3,000 versts. Discussing in detail the cart road, Sidensner draws the conclusion that as a matter of fact it may be considerably shortened, as the first 150 versts pass by the shore of Baikal and the valley of the navigable river Serenga, and the last 350 versts along the shore of the raftable river Ingoda and in part of the Shilka. Thus, the road is reduced to 450 versts, and even here, from the happy direction of many shallow rivers which can easily be made navigable, there only remains the pass across the Yablonovoi range from the Areisk Lake to the settlement of Tanginsk, a distance of 18 versts; and only over this small section will it be necessary to build a railway to unite by a water route the basin of the Volga with the Pacific shore of Siberia. The proposition to carry out surveys in this direction, although met with favour, in consequence of the want of means could not be accepted.

Yet many more schemes were presented, which were discussed both in Government spheres and in scientific societies, but the majority of them suffered from a lack of actual foundation. Special commissions were organized in the Imperial Russian Technical Society and in the Society for Promoting Russian Trade and Industry, which laboured very long upon the consideration of the questions of the route and cost of the Siberian Railway, but to write about all the schemes placed before these meetings, would take up very much time; they fill books. The principal directions are marked upon the map appended to this work, omitting the variations whose name is legion.

Independently of the schemes proposed by private persons, several Governors-General of Siberia began vehemently to urge the necessity of building different sections of the line. Among these petitions, particularly noteworthy are the schemes for sections of the way from Tomsk to Irkutsk and from Baikal to Sretensk put forth by Baron Korf and Count Ignatiev, intended to unite the Western Siberian navigation with that of Eastern Siberia on the Amour. To these two sections a third was soon added, from Vladivostok through Razdolnoe, Nikolskoe, and Anuchino to the Busse Post. The surveys carried out in these directions only touched the technical side of the matter, leaving the economical entirely aside; in consequence of which in 1887 it was not considered possible to proceed to the preparatory works for the carrying out of the schemes referred to. An exception was made only in reference to the

Ussuri line, the construction of which was put in the first rank. This question was in 1890 placed for consideration before a Special Commission, which was also charged with elucidating in what order the different sections should be built, in order as far as possible to lighten the sacrifices of the treasury and draw the greatest advantages from the working of those sections which should be constructed first. In the Special Commission at the end of 1890, when the system of Russian railways projected eastwards in three lines whose extreme points were Tiumen on the Ural line, Miass on that of Zlatoust-Miass, and Orenburg on the Orenburg line, on the discussion of the question of the conditions of the construction of the Great Siberian Railway new circumstances cropped up which somewhat altered the former view of the matter. Strategical views partly gave way before considerations of an economical and commercial character, it being at the same time declared that the aim of the creation of the Siberian railway should consist not so much in the opening in Siberia of new markets for the sale of the productions of European Russia, as in affording Siberia itself the possibility of marching along the road of normal economical development and placing that vast country, so richly endowed by nature but bereft of convenient ways of communication, as far as possible in the same conditions as those which European Russia at present enjoys. Only in close economic communion with European Russia could Siberia grow and develop. On the other hand, European Russia in economical relation with Siberia would draw upon new sources for its development and enrichment.

The commencement of the Siberian railway from the east, that is, from the Ussuri section would not completely answer to the objects laid down, and it was therefore recognized as more expedient to begin this great work simultaneously from the opposite ends in the east and west. The terminus of the line at its eastern end was one starting point, namely Vladivostok, and about this there were no differences of opinion and no disputes. Other point, to the slightest extent suitable for the purpose, there is none upon the Pacific shore of Siberia.

The choice, on the other hand, of the western terminus offered a more difficult problem, which however at last was reduced to the selection of one of the three above mentioned points with which the railway system of European Russia terminated towards the east. From whatever point the Siberian railway was begun, on continuing it into the depth of the country, all three variants must necessarily join approximately at a point near Nizhneudinsk, as is shown upon the annexed map.

Choosing Tiumen as the point of departure the line must be carried to Yalutorovsk and Kainsk, leaving Tomsk by the way, as the taking of it in a more northerly direction, to Tomsk, is excessively difficult in consequence of a desert region covered with forests and swamps. Further on, the line must go to Mariinsk, Krasnoyarsk and Nizhneoudinsk. The distance from Tiumen to the last point is 3,474 versts. If the starting point chosen be the station of Miass, the road will pass through Kurgan, Kainsk, Kolyvan, Mariinsk, Krasnoyarsk and Nizhneoudinsk. The total distance is in this case 2,683 versts. Finally, selecting Orenburg, the line must be taken to Orsk, Atbassar, Akmolinsk, Pavlodar, Biisk, Minousinsk and Nizhneoudinsk. The total extent of the road by this route is 3,400 versts.

Comparing the advantages and excellences of laying down the line in these three directions, the following is the result. Uniting the Siberian road with Tiumen without

connecting it with the general system deprives it of the importance of a line of transit. But if the Ural line be produced from Perm to Nizhni, then in the first place, this distance of 1,000 versts will cost about 71,000,000 roubles, and in the second, the said line from its technical conditions will present many difficulties in the way of profitable through goods traffic. The second route is 791 versts shorter than the preceding, and besides this, embraces the most populous parts of Western Siberia with a chernoziom and exceedingly fertile zone producing much more grain than is required on the spot. The third route traversing several large administrative and industrial centres at the same time passes through a very unsuitable region in its western half. For about 1,500 versts the line goes through waterless, thinly populated steppes little adapted to civilized life, where in winter rage the fiercest winds, in consequence of which there are frequent snow drifts. In its eastern half this route intersects an extensive mountainous district and the carrying through it of a railway will require a crowd of technical complications and an increase in the cost of construction connected therewith. With all this the route in question is 717 versts longer than the preceding. Thus all the advantages proved to be in favour of prolonging the Samara-Zlatoust-Miass railway through Cheliabinsk, Kurgan and so on.

In consequence of all the above, the question of the construction of the Great Siberian Railway was resolved on the 21st of February, 1891, in the sense of proceeding in the same year to the building, by direct order of the Treasury, of the railway from the station of Miass to the completion of the Zlatoust-Miass line in construction to Cheliabinsk, and to the carrying out of surveys from Cheliabinsk to Tomsk or some other point of the middle Siberian section. Finally, by an Imperial rescript given the 17th of March, 1891, in the name of his Imperial Highness the Tsarevich, the question of the construction of the Great Siberian Railway was finally and irrevocably decided in the affirmative.

The Gracious Will of His Majesty the Emperor, clearly expressed in this rescript, put an end to many years of hesitation and doubt as to the accomplishment of the said great undertaking, and now the Government has taken all the necessary measures for the most successful realization possible of this good conception, which has a perfect right to take one of the first places among the most extensive and important enterprises of the expiring century, not only in this country but in the whole world.

The above quoted Imperial rescript was promulgated by the Grand Duke the Tsarevich on the 12th of May, 1891, in Vladivostok, and then His Imperial Highness laid the first stone of this mighty work. In the same year extensive surveys were commenced from the west and the east, and the possibility soon appeared of establishing the following order for the construction of the Great Siberian Railway. The realization of the enterprise was divided into three shifts. To the first was referred the construction of the Western Siberian section from Cheliabinsk to the river Obi, an extent of 1,328 versts, and of the middle Siberian section from the river Obi to the town of Irkutsk, a distance of 1,754 versts, as well as the completion of the section Vladivostok-Grafskaya, in course of construction, and the building of the connecting line between the Ural Mines line and the Siberian railway. To the second shift was counted the construction of the sections from Grafskaya to Khabarovka, 347 versts long, and from the station of Mysovskaya, the point of departure of the line on the other side of Baikal, to

Sretensk, a distance of 1,0(9 versts. To the third shift belongs the building of the Circumbaikal line, 292 versts in length, and from Sretensk to Khabarovka, about 2,000 versts. The works of the first shift are to be completed not later than the year 1900.

The order of construction received the Imperial sanction on the 10th of December, 1892, and on the 10th of March of the present year, 1893, the construction of the Great Siberian Railway was in the following state.

1. The first section of the Western Siberian Railway from the town of Cheliabinsk to the town of Omsk, distance 747 versts.

a. The personal staff of engineers completely organized and already on the spot; b. The alienation of land begun, and signed declarations obtained from the owners as to the compensation required by them; c. The work in connection with the removal of earth given to contractors; navvies hired for the whole extent of the section, and excavators delivered on the spot; earth removed to the extent of 218,000 cubic sagenes or about 20 per cent of the whole quantity; d. Timber cut for the wooden bridges, and cast-iron pipes and iron ordered for the bridges across the rivers Tobol and Ishim; a considerable part of the wooden bridges built for a distance of 240 versts between Cheliabinsk and Kurgan; e. Four hundred thousand sleepers made and 50 per cent of this quantity delivered on the line; f. The laying of the telegraph begun, and already opened for use from Cheliabinsk to Kurgan for a length of 240 versts; g. Material in course of preparation for the buildings on the line and at the stations; h. Twenty thousand casks of cement obtained, and bolts ordered for the whole section.

2. The second section of the Western Siberian Railway from the town of Omsk to the river Obi, a distance of 579 versts.

a. Personal staff of engineers organized; b. Earth-works contracted for the first 100 versts from the town of Omsk; b. Negotiations being carried on with the works for the supply of cement and iron for the bridges and with owners of steamers for the carriage of railway requisites by the Obi water system from Tiumen to Omsk on the river Irtysh and to Krivoshchekovo on the Obi.

3. First section of the Middle Siberian Railway from the river Obi to the town of Krasnoyarsk, a distance of 724 versts.

a. Parties of engineers organized and despatched to the scene of the works for carrying out final surveys and works; b. Earth-works contracted for a distance of 65 versts, the amount of 270,000 cubic sagenes, and navvies hired for carrying out the work with the means at hand; c. Twenty-four thousand casks of cement obtained; d. Negotiations concluded with owners of steamers of the Obi system for the delivery at the village of Krivoshchekovo on the Obi of the cement already obtained and of the iron materials from the Ural and other

works; e. To ensure the works being duly supplied with timber an order issued to proceed to the felling of avenues in the forests and negotiations in course with timber merchants in reference to the building on one of the raftable rivers of a saw mill and the rafting from the head waters of the rivers Obi and Tom of the timber prepared partly by the means at hand, and partly by contract.

4. Ussuri line, a distance of 382 versts.

a. Earth-works carried out to the extent of 380,000 cubic sagenes, or 52 per cent of the total quantity, and laying of pipes and bridges 4,260 cubic sagenes or 65 per cent; b. Sleepers and rails with bolts ordered to the full amount and 20 versts of railway from Vladivostok laid down; c. All the civil buildings in course of construction; d. Rolling stock ordered to the full amount and partly delivered at the scene of operations.

5. Transbaikal Railway, a distance of 1,009 versts.

Parties of engineers organized and despatched to the scene of the works to carry out the final surveys.

6. Siberian Railway from Cheliabinsk to Irkutsk.

a. Ordered 7,400,000 pouds of rails from Ural and European Russian Works, of which 186,000 pouds are received at the works; negotiations in course for the order of the remaining 400,000 pouds required; b. Ordered of various works 148 eight-wheeled engines and 2,300 covered freight cars, and negotiations in course for delivery of the remaining 1,811 cars and platform trucks.

As for, finally, the question of the building of the connecting branch between the Siberian and Ural railways, for its elucidation and for the determining the initial and terminal points of the said line a careful survey will be made on the spot in the course of the present year. It may be further added that there exist three variants of the connecting link, which are shown on the map, namely Ekaterinburg-Miass, Ekaterinburg-Cheliabinsk and Ostrovskaya-Cheliabinsk. The exact cost of this work of course cannot be defined until the final designation of the initial and terminal points of the route is adopted, but it is approximately assumed at 7,000.000 to 8,000,000 roubles, with the condition of the completion of the whole construction in 1894.

CHAPTER XVI.

Topographical and technical features of the Great Siberian Railway.

The Cheliabinsk-Obi; Obi-Irkutsk; Irkutsk-Mysovsk; Mysovsk-Sretensk; Sretensk-Khabarovka; Khabarovka-Grafsk; Grafsk-Vladivostok; the general cost of the seven Cheliabinsk-Vladivostok sections.

FROM Cheliabinsk the line leads to the town of Kurgan in the government of Tobolsk, only diverting from the straight line in order to avoid deep valleys, lakes, marshes and bogs. Further on, the railway is projected to pass through the town of Petropavlovsk to Omsk with the same indispensable departures from the straight line, and at a distance of 5 versts from Omsk it crosses the Irtysh on a bridge 300 sagenes long. After crossing the Irtysh the line enters the Barabinsk steppe, passing through the governments of Tobolsk and Tomsk, through the town of Kainsk, up to the village of Krivoschekov close to which it crosses the Obi on a bridge of 400 sagenes long, at verst 1325.

The section of the Siberian railway from the town of Cheliabinsk to the Obi, with some few exceptions, runs through a fertile zone of chernoziom where climatic conditions are favourable to the cultivation of cereals, especially within the borders of the Ishimsk and Barabinsk steppes, where during the whole length of the line as far as the Obi, a distance of 1,325 versts, there are hardly any obstacles to interfere with the laying down of the line; and only the spanning of four large rivers, the Tobol, Ishim, Irtysh and Obi, necessitates some large earth works and expensive bridges. On account of the level character of the ground through which the line runs, the limiting gradients do not exceed 0.0074 and the radii of the curves, 250 sagenes on this part of the line. After crossing the Obi, the line as far as the town of Achinsk, a distance of 551 versts, wends its way through a hilly country and has to cross five considerable rivers, the Obi, Tom, Yaya, Kiya and Chulym; it was nevertheless found possible here to limit the gradients to 0.008 and the radii of the curves to 250 sagenes, without greatly increasing the amount of earth work. Further on, from Achinsk to the town of Irkutsk, a distance of 1,191 versts, the character of the country completely changes and assumes a mountainous aspect. The line is obliged to cross two large rivers, the Chulym and Yenisei, and also numerous tributaries of these rivers. Most of the Siberian streams in this part of

the country run from south to north, whilst the general direction of the railway is from west to east, and therefore the line must intersect the whole of the spot summit levels of these rivers, only excepting the valleys of some small streams which flow to the east or west. These spot summit levels, composed of the branches of the Altai, Gremiachevsk, Yeniseisk and Sayansk chains, are very high and sometimes so narrow that there is no possibility of diminishing the steepness of the incline. It was therefore found necessary in the sections of the line from Achinsk to Nizhneoudinsk, a distance of 710 versts, and from the station of Uktouisk situated at verst 2,822 to the station of Polovina, at verst 2,968, a distance of 146 versts, or 856 versts altogether, to plan the line with gradients of 0.015, and curves of 150 sagenes radius, and to allow curves of 130 sagenes radius in some places on the ascent from the Great Kemchug river from verst 1,948 to verst 1,954; and on the descent from the spot summit level to the Little Ibriul and Little Kemchug rivers, from verst 1,967 to verst 1,982, the radius of curvature was decreased to 120 sagenes. At verst 2,100 it was again increased to 130 sagenes and on the rest of the line from Nizhneoudinsk to the Uktouisk station and from Polovina station to the town of Irkutsk, altogether a distance of 335 versts the limiting gradients do not exceed 0.009 and the extreme radii of curvature 250 sagenes. A country of this nature entails very considerable earth works; the height of the embankments reaches 9 sagenes, and the numerous ravines and streams necessitate a large amount of constructive works.

The line crosses the Yenisei at verst 2,049 at a spot where the banks are steep and suitable for a bridge, which will be 450 sagenes long. The station of Krasnoyarsk, close to the town of that name, is situated at verst 2,047, before coming to the river. The highest point of the earth works, marked 201.5 sagenes, is situated at verst 1,976, between the Little Ibruil and Little Kemchug rivers, and is 112 sagenes above the level of the river Chulym and 137 sagenes above the Yenisei.

After crossing the Yenisei the line circuits the heights near the town of Krasnoyarsk and begins to ascend to the spot summit level, first along the valley of the Berezovka river, which falls into the Sitik, and thence along the valley of this latter stream, attaining the highest point at verst 2,116. The valleys of the Berezovka and Sitik are enclosed on both sides by high, steep and mostly rocky banks, and the bed of the streams is very winding and in many places changes from one bank to the other, so that the line must either follow the channels of the rivers, or else cross them several times; in such places it is necessary either to strengthen the slopes of the road with stone or to lead off the river; besides this the ravines and the streams falling into the Berezovka and Sitik necessitate numerous bridges and pipes; the length of this ascent is 67 versts, and 82 bridges and pipes will be required. The ascent along the valleys of these rivers is in continuous gradients seperated by horizontal spaces and rises 126 sagenes above the level of the railway bridge across the Yenisei. At verst 2,266 the line reaches the town of Kansku, near which there is a station, and then crosses the river Kan on a bridge 200 sagenes long, which is to be built on caisson foundations. The highest point of the spot summit level between the Yenisei and the Kan is marked 200 sagenes, and is 127 sagenes above the level of the Yenisei bridge and 103 sagenes above the level of the bridge over the Kan.

The remaining distance to Nizhneoudinsk, which is at versts 2,584, gives a considerable amount of work in some places; for instance, at versts 2,460 and 2,462 the embankments are 10 sagenes high, and on the ascent along the valley of the river Toporka it was found necessary to cross two deep ravines over which wooden viaducts are designed with an opening of 115 and 125 sagenes, and a height of 20 sagenes.

From Nizhneoudinsk to Uktouisk station the line passes over a more level country and consequently the limiting gradients are fixed at 0.009 and the radii of the curves at 250 sagenes. Along this distance the line has to cross three large rivers, the Uda, on a bridge 150 sagenes long at verst 2,588, the Iya, on a bridge 100 sagenes long at verst 2,706, and the Oka on a bridge 125 sagenes long at verst 2,830, and intersects two large spot summit levels between the above mentioned rivers, and several small ones besides. On account of the more even character of the country it is not anticipated that there will be any considerable earth works in this section of the line.

From the river Oka the country is again intersected until the station of Polovina is reached, situated at verst 2,968, and here therefore the technical conditions are those applicable to a mountainous section. From Polovina station to Irkutsk, except for the passages across the valleys of the rivers Belaya and Maltinka, the ground is more level, and therefore the line is laid out according to the conditions of a level section. Descending into the valley of the Belaya for a distance of 10 versts down a continuous incline of 0.009, only broken by one level stretch of 200 sagenes, the line crosses this river on a bridge 125 sagenes long. The Irkutsk station is planned at verst 3,065 at a distance of 4 versts from the ferry across the Angara, on the post high road from Moscow to Irkutsk, opposite the town of Irkutsk, situated on the right bank of the Angara where the river Irkut falls into it.

The foregoing short description of the route of the Siberian railway section from the Obi to Irkutsk shows that, starting from that river near 55° north latitude, the line follows a north-easterly direction to the town of Mariinsk, and keeping to the 57th parallel reaches the town of Kansk; at this point the line turns abruptly to the south-east and follows this direction to Irkutsk, situated on the 53th parallel. The line passes through the districts of Tomsk and Mariinsk in the government of Tomsk, the Achinsk, Krasnoyarsk and Kansk districts in the government of Yeniseisk and the Nizhneoudinsk and Irkutsk districts in the government of Irkutsk, and takes in the towns of Mariinsk, Achinsk, Krasnoyarsk, Kansk, Nizhneoudinsk and Irkutsk. Starting from Mariinsk the line passes close to the Great Siberian postal highway, along which the communication is kept up between Siberia and European Russia; the railway in some places crosses it and in others diverges a short distance from it, except in the Krasnoyarsk-Kansk section where, on account of the difficult nature of the country, it was in some places necessary to plan the line at a distance of 30 versts from the high road in order to reduce the amount of work required to lay it.

From Irkutsk the line leads to lake Baikal and follows the shore for a distance of 162 versts as far as Mysovsk station. The laying of this section of the line presents considerable difficulties. From verst 3,088 to verst 3,108, before crossing the river Irkut, the line passes along the valley which is flooded by the high waters of this stream. Further on, at verst 3,112, the valley of the Irkut becomes narrow and takes the appearance of a mountain pass

bounded by steep rocky slopes which in some places give way to over-hanging granite crags, in the cuttings of which the line will have to be laid, supported for considerable distances by retaining walls; in many places the slope of the line will fall into the Irkut, which, like all mountain rivers, has a very strong current; here stone dikes will have to be built and the foot of the slope strengthened with retaining walls laid in cement. Further up the river the steepness of the windings of the Irkut increases, so that at verst 3,146 it was necessary to make the line pass through a tunnel 32 sagenes long. From verst 3,163 to verst 3,166 the line crosses the Zyrkyzunsk chain where it diverts the course of the river Irkut far to the west and forces it to make a loop for a distance of about 30 versts; in order to shorten the line by this distance of 30 versts it is proposed to build a tunnel 1,790 sagenes long.

The work of boring the tunnel will take a long time as it is designed with one continuous incline, so that it cannot be bored from both ends. A no less obstacle will be experienced in the construction of the line further on; great difficulty is occasioned by the gorge where the river Ilcha falls into the Kultushnaya, as the curves at the foot of the almost vertical rocks 50 sagenes high are so sharp that it is impossible to bring the line round them even with curves of 120 sagenes radius, so that it will be necessary to lay the line along part of the channel of the rapid mountain stream of the Ilcha which even forms a waterfall at this point; in addition to this, springs flow out of the rocks and these will have to be led under the line. Here the height of the embankment reaches 16.8 sagenes, and the height of the retaining wall 17 sagenes, which on account of the nature of the locality must be laid in cement. This mountainous character of the ground continues from where the river Kultushnaya falls into lake Baikal to the Bystraya station, 3,212 versts from the town of Cheliabinsk. Along the whole of the mountainous section all the cuttings will have to be made in hard rocky ground, such as granite, gneiss, sandstone, and the like, and in some places the embankments will have to be made of stone, as there is no soft soil at hand. The greatest depth of the excavations in this section is 11 sagenes, and 15 sagenes at the entrance of the tunnel, and the largest embankments have a height of 16.8 sagenes.

From verst 3,212 the line follows the shore of lake Baikal, and although it loses its mountainous character, it crosses in many places the branches of the mountain chains leading to lake Baikal. In some places the track is close to the shore and in others at a little distance from it; sometimes it is necessary to lay the line close to the edge of the water, partly taking advantage of the rocky shoals and partly holding on to the rocks; in those places where the shoals at the foot of the rocks completely cease, the batter of the road bed slopes directly into the water, and in such cases requires strengthening from the destructive action of the waves by means of blocks of rock or cribwork filled with stone. Finally there are places along the shore of lake Baikal through which the line passes that are of a marshy character, overgrown with wood. All along the shore of the lake the line will have to cross numerous streams with rapid currents forming small torrents in places where stones, brought down by the current, have accumulated; all this will entail a large amount of constructive work and the innumerable spring which gush out of the rocks surrounding the lake will require a vast expenditure of labour to lead the water off from the road bed.

In consequence of these difficult topographical features of the country, the Irkutsk-Mysovsk section requires 1,000,000 cubic sagenes of earth work, or almost 3,690 cubic sagenes per verst, costing 4,772,000 roubles; in addition to this, 235,000 cubic sagenes, or about 800 cubic sagenes per verst, of cuttings in stony ground have to be done; also 24,800 cubic sagenes of masonry have to be laid in the retaining walls, and 4,950 cubic sagenes of this must be built with hydraulic cement, and the remainder, dry. The country through which this section of the line passes is completely desert, excepting the town of Irkutsk and some small settlements on the shores of lake Baikal. Although the climate is severe, the proximity of such an enormous quantity of water causes a great deal of moisture to be deposited, so that the ground is covered with a thick and early layer of snow in consequence of which that eternally frozen subsoil, which is found further along the Siberian railway, is not met with here.

From Mysovsk harbour on the southern shore of Lake Baikal the line runs along the shore of the lake and then follows the valley of the river Selenga; at a distance of 157 versts it crosses this river on a bridge 455 sagenes long and enters the valley of the river Uda. The town of Verkhneoudinsk is situated near the junction of the Uda and Selenga. The further progress of the line is determined by the choice of the most advantageous spot to cross the Yablonovoi chain, and after much reconnoitering, it was found that the best route was first along the valley of the river Uda and then along the river Pogromnaya which falls into the Uda, where the line enters a plain covered with lakes, called the Vitimsk plateau, and then along the river Domna, one of the tributaries of the system of the river Lena. Passing the spot summit level between the two above mentioned rivers, the line continues ascending the eastern slope of one of the branches of the Yablonovoi chain, and at verst 3,838 attains its highest point 529 sagenes above the level of the sea. The Yablonovoi chain serves as the spot summit level of the basins of the Lena and Amour, that is, of the Northern and Pacific oceans. The pass across this chain at the highest point, at verst 3,943, is 490 sagenes above the level of the sea, and consequently lower than the pass across one of the branches of the chain. From this spot summit level the line gradually descends and sweeping round the hilly side of the district town of Chita by the bank of the river Shilka, it reaches the village of Matakan, situated opposite the town of Sretensk, which stands on the right bank of the above mentioned river.

The most difficult part of the line as regards earth and constructive works is the section from the town of Chita to the town of Sretensk along the valleys of the Ingoda and Shilka rivers. The valley of the former is narrow and winding, the mountains surrounding it are quite close to the river, forming steep slopes or projecting headlands, and in most places there is only a narrow space between the mountain and the river, which is almost always inundated when the level of the water rises. In a few places the valley of the river is sufficiently wide to admit of the possibility of conveniently drying the track. In this region the line either hugs the declivities or passes through submerged meadows but always keeps to the left bank of the Ingoda river. The upper part of the valley of the Shilka resembles the valley of the Ingoda, and its character only somewhat changes after verst 4,248; the direction of the river does not wind so often, the curves have a more open outline and

instead of separate headlands, high rocky slopes, some 10 versts long, descend into the river these slopes are to be used for carrying the railroad track.

On account of the local features which have been described there is a very considerable amount of earth work to be done in the Mysovsk-Sretensk section. The total quantity amounts to 2,032,000 cubic sagenes, or 2,014 per verst, and the cost of it is estimated at 8,859,000 roubles. The deepest excavagations are 16.62 sagenes, and the highest embankments 10.87 sagenes. Almost all the cuts in the valleys of the Ingoda and Shilka rivers, and many of those on the remaining portion of the line, will have to be hewn out of hard, rocky formations, so that out of 500,000 cubic sagenes excavations, 300,000 have to be cut out of rocky ground. Furthermore, the cuttings in the Yablonovoi chain are saturated with water, which can only be drawn off with great difficulty, the soil is also in many places perpetually frozen and the excavations in such ground are 3.64 sagenes deep, and therefore, the only conclusion to be arrived at is that the earth work in this section will be of an exceptionally difficult character. Besides this, in consequence of the steepness of the slopes of the banks of the Ingoda and Shilka rivers, all the embankments along them will have to be supported by retaining walls to the amount of 56,000 cubic sagenes along a distance of 300 versts.

The difficulty of laying this section is further increased by the exceptional climatic conditions of the locality through which the line passes. The climate of the region beyond lake Baikal is quite continental; on account of its severity the changes of temperature are extreme; thus, on the Yablonovoi chain in June and July the day temperature rises to 25° Celsius and during the night falls to — 5°. The air is characterized by its extreme dryness and the amount of moisture which falls during the year is inconsiderable. There is such a small quantity of snow that along the whole of the line to the lower part of the river Selenga the ground is hardly covered with it. Only there and along the shore of lake Baikal does the sledge road last any considerable length of time; along the rest of the distance from Verkhneoudinsk to the east, sledge roads are very rare and sledges are only driven along the ice on the rivers.

From meteorological observations recorded, it was shown that at Verkhneoudinsk in 1886 the temperature was only above freezing point for the three summer months; in 1887 during one summer month it was above zero, and at almost zero during two months; in 1888 it was above zero for two months, and during the three years period from 1886 to 1888 the highest temperature was in July, + 37° Celsius, and the lowest in January, — 47° Celsius, whilst on the Vitimsk plateau and the Yablonovoi chain even in summer a temperature of —5° Celsius was recorded. Furthermore in the upper part of the river Uda, on the Vitimsk plateau, in the Yablonovoi chain, and in the valleys of the Konda and Chita rivers, there is a perpetually frozen subsoil. The depth to which the soil is frozen, according to investigations made in the valley of the Chita river at a height of 340 sagenes above the level of the sea, was on the average $3^1/_2$ sagenes, and in summer the ground thaws to a depth of 1.83 sagenes, so that the remaining stratum, 1.67 sagenes thick, is eternally frozen. On the Vitimsk plateau and the Yablonovoi chain the ground in summer thaws only to the depth of three-tenths of a sagene, and in the valley of the Kondyn river, to a depth of six-tenths of a sagene.

The continuation of the Siberian railway from Sretensk situated on the Shilka, a tributary of the Amour, up to the town of Khabarovka standing on the right bank of this latter river, a total distance of 2,000 versts, has not been thoroughly investigated in detail, and only some slight reconnoitering has been done, which shows that from verst 4,350 to verst 4,900 the line will have to be laid along the valleys of the Shilka and Amour. Further on, the line may be shortened by diverting it from the Amour and crossing it at verst 6,350 on a bridge, 1,200 sagenes long. The construction of the line will be subject to the same topographical conditions as the line of Mysovsk-Sretensk, besides which the construction of the line of Sretensk-Khabarovka will be rendered more difficult by the completely desert nature of the country covered with dense virgin forests, the silence of which has never been broken by the voice of man, especially in those places where the line diverges from the Amour where there is a total absence of any habitation or means of communication, and likewise in consequence of the necessity of conveying workmen and all ready-made railway appliances from European Russia by a circular route across the Pacific Ocean.

After crossing the Amour the line for a distance of 400 versts follows the valley of the river Ussuri which falls into the Amour and makes the boundary between the Russian and Chinese empires. The valley of this river is by no means wide and the numerous streams falling into the Ussuri separated by high spot summit levels, formed by the branches of the Sikhotee-Alin chain, entail a large amount of constructive works. The largest bridges are planned at versts 6,445, 6,585 and 6,697 across the Khor, Bikin and Iman rivers; they will be each 120 sagenes long. In some places the track approaches the edge of the Ussuri and it will be necessary to support the slope of the earth work. At verst 6,755 the line crosses the Ussuri river on a bridge 120 sagenes long. Further on, the line follows the foreland of lake Khanka and the valley of the Lefu river which falls into this lake before reaching the Nikolsk station at verst 6,982. Starting from this station the line runs along the valley of the Suyfun river, sometimes traversing places submerged by the waters of that river, and sometimes crossing the branches of the mountain chains approaching it; in these cases it is necessary to lay the track with an incline of 0.015, whilst the gradients on the whole of the other part of the line from Khabarovka to Vladivostok do not exceed 0.008. The line issues from the valley of the Suyfun river and passes on to the shore of the Ouglov and Amour gulfs, terminating at the town of Vladivostok, the station being situated on the shore of the bay of the Golden Horn. The total length of the Siberian railway from Cheliabinsk to Vladivostok along the main line is 7,083 versts, and 7,112 versts including branch lines to the principal rivers intersecting the main road.

For superintending the work of laying down the railway and in accordance with the gradations to be observed in its construction, the line is to be divided into seven sections: the Western Siberian from Cheliabinsk to the river Obi, including branch lines 1,328 versts; the Central Siberian from the Obi to Irkutsk, 1,754 versts; the Baikal circuit from Irkutsk to the pier of Mysovsk on lake Baikal, 292 versts; the Transbaikal from Mysovsk pier to the town of Sretensk on the Shilka river, 1,009 versts; the Amour section from Sretensk to Khabarovka on the Amour, 2,000 versts; the North-Ussurisk from Khabarovka to the village of Grafsk, 347 versts; and the South Ussurisk from Grafsk to Vladivostok, 382 versts, or 7,112 versts in all.

In 1891 and 1892, as has already been mentioned, the work of laying the two extreme sections, the West Siberian and the South Ussurisk, was commenced; and in 1893 work was begun on the Central Siberian section from the Obi to Krasnoyarsk. The South Ussurisk section will most probably be terminated in 1894, and the other two in 1896. In 1895 the North Ussurisk section will be commenced and in 1896 the rest of the Central Siberian railroad from Krasnoyarsk to Irkutsk will be begun, the first section of which will be finished in 1898, and the second, in 1900. In 1899 work will be commenced on the Transbaikal and Amour sections, and in 1900 the Baikal circuit will be begun; these will probably be finished in 1904. The whole line across Siberia, 7,112 versts long, will therefore be terminated in 12 years, counting from 1893.

Considering the sparseness of the population of the country through which the Baikal circuit, Transbaikal, Amour and Khabarovka sections pass, in consequence of which it will be necessary to send workmen mostly from European Russia, and also on account of the terms allowed for laying the Khabarovka, Transbaikal and Amour sections, when planning out the Siberian railway it was decided that navvies, masons and other special workmen, and also rails, fastenings and rolling stock, iron parts of bridges et cetera, would be sent as follows: for the Khabarovka section by sea to Vladivostok, and then further on by the Ussuri railway; for the Transbaikal section, also partly by sea to Vladivostok, then by rail to Khabarovka and then by the Amour and Shilka rivers as far as Sretensk, and partly by rail to Irkutsk and then by the Angara river and lake Baikal to Mysovsk pier; for the Baikal circuit section, by rail to Irkutsk; and for the Amour section, partly from the east by the same route as that used for the Transbaikal section, and partly from the west, by rail to Irkutsk, by water from Irkutsk to Mysovsk and then by the Transbaikal line to Sretensk. In general the object in view was to establish as quick as possible an uninterrupted steam communication between European Russia and Vladivostok through the whole of Siberia and to take temporary advantage of the water roads. These circumstances determined the system of gradation to be observed in laying the track in its separate sections. Thus the first stage of the work consists in laying the line to Irkutsk and finishing that already begun from Vladivostok to Grafsk; the second stage consists of the sections between the rivers necessary for the establishment of steam communication through the whole of Siberia, partly by railroad and partly by water; finally, the remaining sections which join up the works of the first and second stages into one continuous railroad are relegated to the third stage. As regards however the carrying out of the details of the plan of building the Siberian railway from Cheliabinsk to Vladivostok, it must be observed that the order of building the Western and Central Siberian sections from Cheliabinsk to Irkutsk can be fixed upon with the greatest certainty as they have been subject to more detailed investigation, this part of Siberia being nearer and more accessible from European Russia, more densely populated and its climatic and topographical conditions more favourable. The plan of carrying out the Grafsk-Khabarovka section may also be regarded as quite clear, as it closely resembles the Ussurisk line.

With reference to the Baikal-Circuit, Transbaikal and Amour sections, it is necessary to mention that the proposed dates of the termination of these lines may be liable to change on account of the totally different conditions under which they must be built, compared

with the Cheliabinsk-Irkutsk line. The Irkutsk-Khabarovka line has been but little invistigated; it is far removed from European Russia, and passes through a desolate country with exceptional climatic and topographical conditions. The plan of building these three sections can therefore only be regarded as approximately correct, and in all probability the experience gained in laying the western portion of the Great Siberian line will determine the order and method to be undertaken in laying the eastern portion. In any case it will be necessary to make a second, final set of investigations from Irkutsk to Sretensk, and more detailed observations of the Amour section.

The Siberian railway, passing through an enormous expanse of country under the most widely differing topographical conditions could not be all included in one general technical type; and in order to diminish the cost of construction it was necessary to make some modifications in the technical conditions in general, and for the mountainous sections in particular; the basis of these modifications and simplifications has however been taken as a good and reliable construction, capable of being afterwards, in case of necessity, complexed and enlarged, but not in any case requiring the reconstruction of the line.

The limiting gradients on the level country sections have been fixed at 0.006 to 0.008 and the radii of the curves at 250 sagenes; in the mountainous sections the gradients have been taken from 0.015 to 0.0174 and the radii at 120 sagenes.

It is proposed to make the earth work for a single track of the ordinary width, 2.35 sagenes wide on the embankments, and 2.20 sagenes wide in the cuts. The normal batter of the embankments and cuts, as high as they go, will be $1^1/_4$ for ordinary kinds of soil.

For the passage of water under the line and for crossing rivers, cast iron and stone pipes and wooden bridges will be laid, where the force of the moving ice or the character of the soil do not present any obstacles; over the large rivers permanent iron bridges with stone piers will be built. Rails of 18 pounds weight per foot run will be used along the line on a layer of ballast, 0.125 of a sagene thick, under the bottom of the rail. The dwelling houses for the overseers of the line, plate layers and watchmen will be built of all kinds of wood and of the simplest construction, adhering as much as possible to the local styles of building; the wooden buildings will be without foundations, on wooden or stone columns. All crossings in general will be left unguarded except those in towns or thickly populated points.

The greatest distance allowed between the stations is 50 versts, which corresponds to a running capacity of 3 sets of trains; in order to increase this capacity to 7 sets of trains per 24 hours on the main line horizontal spaces have been planned to admit of intermediate stations and sidetracks being made in case of necessity.

Separate passengers buildings, built of brick or wood and as small as possible, will be erected only at those stations where a large number of passengers may be expected, or where it will be necessary to provide refreshment rooms; at all other points some accommodation will be set apart in dwelling houses for the requirements of the station service or the convenience of casual passengers.

It is proposed to acquire sufficient rolling stock for the Siberian railway to be able to form 3 sets of army trains per 24 hours, composed of 60 axles, one set of trains being

composite consisting of passenger and freight cars; the engines are to be eight-wheeled: the passenger cars, partly eight-wheeled and partly six-wheeled, and the freight cars, four wheeled.

On account of the importance of the water supply to the traffic of the line and the difficulty of increasing it ultimately, it has been decided to arrange it only at the stations, that is, at distances of 50 versts, but to provide sufficient water for the passage of 7 sets of trains. In order to increase the water supply when required a supplementary apparatus of the simplest type may be provided at points between the stations.

Based upon these technical conditions, a preliminary estimate of the cost of building the Great Siberian Railway has been calculated, including rails, fastenings, rolling stock and permanent bridges across the large rivers. The distribution of the expenses according to the class of work is shown in the table on the following pages.

The estimate of the cost of constructing the Great Siberian Railway, as shown by the following table, does not however include all the expenses which this enterprise entails. In order that this undertaking might with greater ease fulfill the numerous obligations which devolve upon it, it has been deemed advisable to assist in the accomplishment of a number of auxiliary measures in conjunction with it, with the object on the one hand, of facilitating and diminishing the cost of the line itself, and on the other hand of increasing the economic and progressive influence which it will excercise on the prosperity of Siberia. The first of these auxiliary works is the construction of a branch line between the Siberian and Ural railways, in order to make use of the products of the Ural metallurgical works, as much as possible, for building the main line. Furthermore it has been decided to build some river wharves and lay branch lines to them; to improve the Siberian rivers in order to facilitate the transport of building materials; to assist the development of river steam navigation upon those river systems which adjoin the Siberian railway, and which are capable of being closely connected with it; to establish a route through the Northern Ocean to the mouths of the Obi and Yenisei; to assist colonization on the Siberian land in the region near the line; to encourage the iron works which may be established in Siberia near the railway; to form geological expeditions for continuing the geological investigation of the country which has already been commenced; to make an exhaustive description of the Amour district, et cetera.

To carry out these auxiliary enterprises during the time appointed for completing the sections of the first stage a sum of 14 million roubles has been put aside out of the Siberian railway building fund. When the work of the second and third stages is commenced, in all probability special sums will be in like manner appointed for carrying out the auxiliary enterprises, exclusive of the estimate of the cost of building the Great Siberian Railway.

CLASS OF WORK.	Cheliabinsk-Obi, 1,328 versts.		Obi-Irkutsk, 1,754 versts.		Irkutsk-Mysovsk, 292 versts.	
	Total in roubles.	Roubles per verst.	Total in roubles.	Roubles per verst.	Total in roubles.	Roubles per verst.
A.						
Expropriation of land	387,857	292	299,727	171	48,970	168
Making the tract	5,845,144	4,401	12,909,873	7,360	7,198,844	24,654
Construction works	8,932,135	6,726	16,544,912	9,738	7,116,950	24,374
Laying the line	3,923,854	2,955	4,464,685	2,545	742,049	2,541
Appurtenances of the line . . .	176,140	133	257,701	147	36,675	126
Telegraph	367,773	277	358,074	204	70,201	241
Buildings along the line	709,360	534	849,227	484	196,860	674
Station buildings	2,012,500	1,515	2,767,225	1,578	557,300	1,906
Water supply	617,840	465	1,304,195	743	178,730	612
Station appurtenances.	659,050	496	748,955	427	197,150	675
General, administrative and unforseen expenses	4,500,570	3,389	5,525,115	3,150	1,510,575	5,174
Total . . .	28,132,223	21,184	46,029,689	26,243	17,854,304	61,145
B.						
Rails and fastenings	8,583,922	6,464	11,550,900	6,585	1,867,108	6,394
Rolling stock and workmen included	8,086,700	6,089	10,691,950	6,096	1,671,730	5,725
Carriage of rails, fastenings and rolling stock	2,558,634	1,926	5,000,359	2,851	917,678	3,143
Total . . .	19,229,256	14,480	27,243,209	15,532	4,456,516	15,262
Grand total . .	47,361,479	35,663	73,272,898	41,775	22,310,820	76,407

Mysovsk-Sretensk, 1,009 versts.		Sretensk-Khabarovka, 2,000 versts.		Khabarovka-Grafsk, 347 versts.		Grafsk-Vladivostok, 382 versts.		Total cost of the 7 sections, 7,112 versts.	
Total in roubles.	Roubles per verst.	Total in roubles.	Roubles per verst.	Total in roubles.	Roubles per verst.	Total in roubles.	Roubles per verst.	Total in roubles.	Roubles per verst.
501,695	497	1,000,000	500	76,000	219	247,640	649	2,561,889	360
13,237,808	13,120	28,000,000	14,000	4,582,353	13,206	1,712,806	9,724	75,486,828	10,614
9,869,932	9,782	30,000,000	15,000	3,320,712	9,570	2,657,280	6,960	78,441,921	11,030
2,931,002	2,905	6,000,000	3,000	1,344,325	3,874	1,189,760	3,116	20,395,675	2,896
168,523	167	320,000	160	86,722	250	62,270	163	2,108,031	156
242,106	240	480,000	240	104,252	300	118,420	310	1,740,880	245
587,460	582	1,000,000	500	314,400	906	218,375	572	3,875,682	545
1,867,450	1,851	3,600,000	1,800	881,250	2,542	1,170,150	3,065	12,856,575	1,808
638,200	632	1,200,000	600	249,660	720	316,750	830	4,505,375	633
734,110	728	1,400,000	700	248,500	700	398,100	1,043	4,385,865	617
5,410,800	5,362	11,000,000	5,500	2,002,125	5,700	2,908,336	7,613	32,857,521	4,620
36,189,140	35,866	84,000,000	42,000	13,210,999	38,073	12,999,887	34,045	237,416,242	33,524
6,442,416	6,385	12,765,528	6,383	2,254,200	6,496	2,443,851	6,401	45,907,925	6,455
5,614,345	5,564	11,223,655	5,612	1,917,670	5,526	1,359,200	3,563	40,565,250	5,703
5,063,916	5,019	9,566,652	4,783	1,355,713	3,907	858,113	2,248	25,321,065	3,560
17,120,677	16,968	33,555,835	16,778	5,527,583	15,929	4,661,164	12,212	111,794,240	15,718
53,309,817	52,834	117,555,835	58,778	18,738,682	54,002	17,661,051	46,257	350,210,482	49,242

CHAPTER XVII.

The importance of the Great Siberian Railway.

The importance of the Great Siberian Railway to progress; its bearing upon rural economy, colonization, metallurgical industry; gold mining, internal and foreign trade.

THE enormous expenditure of 350 million roubles entailed by the construction of the Siberian railroad, which probably for a long time will not prove remunerative in the strict sense of the word, is explained by those numerous advantages not subject to arithmetical computation which may be attained by the Government with the realization of this grand enterprise. The previous historical-statistical article has demonstrated that the principal barrier to the development of culture in Siberia is the absence of regular communication, on the one hand between the most important administrative and industrial centres of Siberia, and on the other hand between Siberia and European Russia. Consequently when this principal obstacle is removed the causes will disappear which have for such a long time retarded the regular peopling of this extensive and richly endowed region and the rise in the culture of the aborigenes and settlers. In reality the Great Siberian Railway, intersecting the whole of Siberia for a distance of 7,112 versts, embraces a very wide zone, which cannot be taken at less than 100 versts on either side of the line, or about one million and a half square versts. This enormous area, which exceeds the whole extent of central Europe, Germany, Austro-Hungary, Holland, Belgium and Denmark, lies in the mean geographical latitudes, and as regards climate and soil possesses all the qualities favourable to the development of agriculture, rural economy and the industries connected with them. It is worthy of attention also, that according to the propitious choice of the direction of the Great Siberian Railroad which connects the fertile lands of Western Siberia and the distant region of Ussuri, also embraces the richest deposits of the noble metals, as will be seen by the accompanying map of the Russian Empire. If it be also remembered that the chosen route connects the extensive basins of such large rivers as the Obi, Yenisei and Amour and part of the Lena, it cannot be disputed that the line when once laid will give a powerful impetus to the whole economical development of the country, and will call into existence many new branches of industrial activity.

Turning to the more intimate influence of the Great Railroad upon the various features of industrial and economic life in Siberia, it is necessary to pause over the following. It is first of all evident that the chosen route traverses the rich Ishimsk, Barabinsk and Kulun-

dinsk steppes which have always been renowned for their fertility, and serve as a granary for Siberia. Figures have been already quoted showing that even the opening of the Ural line would be sufficient to cause an increased activity in these steppes and to forward considerable quantities of grain to the west, partly to the Baltic seaports. If the influence of the Ural line was so great, connected with these lands only by water communication, then an uninterrupted line of rails connecting them with the general network of lines in the Russian Empire ought to elicit a far greater increase of agricultural development. Under favourable conditions of soil and climate the productive power of the earth will draw an increase of population and have an indirect influence upon the regular colonization of the country.

Of late years in many parts of European Russia the increase of population from natural causes has brought about an excess of the labouring contingent, and the systematic increase of the number of peasants insufficiently provided with land, due to this fact, has already for some time past attracted the attention of the Government. Being desirous as far as possible to regulate the distribution of farms among the peasants and to provide the sufferers with the requisite amount of land, the Government has found it advisable to adopt certain measures tending on the one hand, to people the unpopulated fertile districts, and on the other hand, to give a regular outlet to the energies of the peasants insufficiently provided with land who are at present a burden on the State, and demand increased solicitude.

For these reasons free Government lands in the above mentioned localities are granted to settlers, and for their benefit a cheap rate has been fixed for conveying them by rail; in some cases they receive loans of money from the Government and certain other privileges are granted to them in order to assist them in the difficulty of emigrating, and of acquiring new household goods. Thanks to the immediate connection by rail between the «Granary of Siberia» and those governments of the Russian Empire where a lack of land is apparent, the enterprise about to be realized should become an excellent emigration regulator in the interests of the State in general. Taking into consideration the extent already given of suitable colonizing land in Siberia, it may be expected that in spite of the tendency of late years for emigration to Siberia, this country will for a long time be able to receive freely those who are desirous of availing themselves of its productive power, so great is its size and so vast the amount of suitable land for agricultural purposes.

When once the newly populated regions show signs of activity, the force of intellect will gravitate thither from European Russia and capital will find more advantageous use in the wider enterprises of industry. This might be encouraged by granting certain privileges in acquiring Crown lands to Russian nobles and other individuals in the Government service, who, as a more educated and cultured element, would be able to bring a civilizing influence with them. Thus the Great Siberian Railway, animating the uninhabited fertile lands ruled by the Governor-General of the steppes and opening up an extensive market for the sale of all products of the earth, would at the same time assist the successful solution of one of the most difficult problems of the State, namely, the definite organization of the economical condition of the peasants badly provided with land in the internal governments of European Russia.

The review of the mineral wealth and mining industry of Siberia has shown how enormous are the riches in the bowels of the country, and what little use has been

made of them up to the present time. Iron and coal, the two great factors of industrial development, are found nearly over all Siberia and in very rich veins. The proper working of these riches will give a powerful advancement to the development of progress in Siberia The contiguity of veins of coal and iron ore in some places has led to the establishment of a few iron works, which have however not been in a very flourishing condition on account of the small demand and their great distance from the markets. These obstacles will disappear when the Siberian railway is constructed, as the railway itself will require such an enormous quantity of iron and iron goods that it can easily furnish enough work for several large iron works besides increasing the output of these works by bringing their goods within the reach of more distant markets. In spite of the enormous production of the Ural iron works, they will be unable to supply all the requirements of the Siberian line for iron goods; being comparatively cheap, they cannot be conveyed very long distances by rail. The appearance of iron works in Siberia, and more especially in the centre or the east, may be regarded therefore as a very natural conclusion; and if in addition to this it be mentioned that in order to enliven the native industry, the Government intends to render some assistance to private individuals in erecting such works, the future of the iron trade in Siberia may be considered quite assured. As regards mineral fuel, which is of such great importance in working a railway line, such quantities of it have been discovered in the formations that have been investigated, that the road will be well supplied for very many years to come. Although coal is found scattered along almost the whole line, wood is in many places so cheap that it can successfully compete with it, especially in those parts of the route which are intersected by navigable rivers, along which the wood may be floated from distant and wild places where vegetation is so rapidly renewed, and where there is no demand for it.

The Great Siberian Railway will also have a great influence upon gold mining. Placed in very difficult economic circumstances, this industry has only prospered in those places where very auriferous formations are worked; many of them are now neglected only because the present price of labour and machinery and the difficulty of obtaining credit upon easy terms do not admit of their being worked with sufficient profit. In America and in other countries, where gold mining is carried on, much poorer beds are worked, and therefore the output is larger than in Siberia. The Siberian railway should strive as far as possible to facilitate and cheapen the carriage of stores and implements to the gold mines, and also increase the supply of labour as many of the mines are suffering from an insufficiency of it. Under new conditions the cost of gold mining would inevitably decrease and this would enable poorer deposits to be worked. The output of gold would also considerably be increased and the industry would acquire a firmer foothold.

Turning to the question of the influence of the railway upon the extension of local trade, it is beyond a doubt that this influence will be most considerable; many articles or raw materials, for which there is at present no local demand, will find a ready sale at more distant markets; the rapid fluctuations in the prices of necessaries and the exceedingly high prices current at present will no longer exist, thanks to the rapid transport of goods.

All the above mentioned advantages which trade will derive from the Siberian railway are only the most intimate changes which will result from the opening of the line and the

new position of commercial intercourse between European Russia and Siberia on the one hand, and within the borders of Siberia on the other hand. In order, however, to grasp the whole extent of the actual importance of the Great Siberian Railway for Russian trade, the scope of vision must be enlarged and the probable consequences of this enterprise must be examined in connection with the fact that uninterrupted railroad communication will be established between Europe and the Pacific and the Far East. Thus the Siberian railway opens a new route, and new horizons for universal, as well as for Russian trade. This was clearly understood by the Russian merchants, whose representatives at the fair of Nizhni-Novgorod in 1889 expressed their hopes connecting the Russian merchant class with the realization of this enterprise in an address on the Siberian railway in the following terms: «This railroad will be of immense economic importance to Russia, and will give a great impulse to Russian industry; it will connect 400 million Chinese and 35 million Japanese with Europe through Russia. The strenuous endeavours made by Germany to gain possession of the markets of the Pacific, and the efforts which have been made to complete the Panama Canal visibly show that the economic struggle already commenced will end on the Pacific Ocean. The Canadian railroad has now appropriated part of the freights of silk, tea and furs which previously reached Europe through the Suez. Undoubtedly part of these goods will pass through Russia as the journey from Europe through Vladivostok to Shanghai will be made in 18 or 20 days, instead of 45 through Suez or 35 days at present by the Canadian railway».

It is particularly important for Russia that this change in the direction of the traffic between Europe and the east of Asia should be to its advantage, and taking part in this communication with a continuous railroad more than 10 thousand versts long it can reap all the advantages not only in the conveyance of goods from the east of Asia and west of Europe, but also those of a large producer and consumer more closely connected than all others with the people of the east of Asia. The Siberian line will therefore not only have the effect of increasing the importance of Russia in the universal markets but new sources of national wealth will abundantly open around her.

It may be added that China, Japan and Corea, whose united populations amount to over 460 millions and whose international trade turnover exceeds 500 million roubles in gold, have not reached by far the limit of development of their commercial intercourse with Europe, but are rather undergoing the elementary stage of it. The internal provinces of China, being further removed from the shore are but little accessible to Europeans; but when once China has opened its ports to international trade, the provinces which have as yet been but little frequented by Europeans, will in the natural course of events sooner or later enter the international markets and carry on international commerce. In any case the commercial intercourse between Europe and China has every reason to extend, and it is therefore not surpising that the nations of Europe are making strenuous endeavours to gain possession of the eastern markets of Asia and do not hesitate before any expenditure likely to lead to this object. But in this respect, owing to its contiguity to these above mentioned rich countries, Russia possesses important advantages over all the other nations of Europe. Thus, at a distance of only 4 to $4^1/_2$ thousand versts from the Volga, the Siberian railway approaches so near to the Chinese frontier, that it would be quite possible, by means of a branch line running into

the borders of China, to start direct commercial interchange with the thickly populated internal provinces of China; in that case the Russian trade with China would extend very rapidly and the revenue of the main line of the Siberian railway would materially increase as well as the importance of Russia in the international trade with China. Taking also into consideration the predominating class of goods in the international trade of China, it is evident that the rather more expensive railway freights compared with those by sea, to some extent equalized by the smaller insurance charges, would not be an obstacle, hindering the transfer of Chinese goods from the sea route to the overland; and 58 per cent of the Chinese export trade is composed of two highly expensive articles, namely tea and silk. Besides quickness of transport and other conveniences, assuring the preference to railway transportation, there are yet particular circumstances, which in the mutual interests of China and Russia, will conduce to the transfer of the transport of tea to the railway route. In the present export trade of China, England plays the most important part, but at the same time she is striving to compete with China in the production of tea and has met with some success as the tea plantations in the Asiatic colonies of England, in India and Ceylon, supply the greatest amount of tea to the whole of Great Britain. There are many favourable conditions in the English colonies which contribute to the success of this competition; among others the network of railways in India is of great advantage in conveying the tea to the ports which are twice as near to Europe as the Chinese ports. On account of the above mentioned circumstances the export of Chinese teas to London and to other countries is rapidly declining, and this is not only a great loss to a large part of the population of China, but for the Chinese treasury also, as tea is subjected to a high export duty in China. In all probability the continued decline of the tea trade will be a very serious question for China, and in this respect the Siberian railway may serve as a great support to the Chinese tea trade, by delivering Chinese teas much quicker in Europe, not only compared with the sea voyage from China through London, but much quicker than the transport of Indian teas. Therefore not only Russia, but China also, is most anxious that Russia should take an active part in the carriage and sale of tea in Europe, as Russia is one of the largest and continually increasing markets for the consumption of tea.

This tangible analogy of the interests of the two countries in the export of tea can but conduce to the gravitation of other Chinese exports towards the new route to Europe, especially as the other principal article of the Chinese export trade, silk, will not only be capable of bearing the expense of a long railway journey, but can also be woven in Russia.

Russia on the other hand, through the agency of the Siberian railway, will be able to take a much more active part in supplying China with those goods which are now imported thither from other countries, and in this respect Russia may meet with particular success in exporting cotton and woollen goods, and even metals, which together compose about one-half of the whole Chinese import. The former on account of their high value compared with their weight, may be conveyed from Moscow, or even from beyond Moscow by rail, and the metals may be brought to China from the Ural, or better still from the nearer mining districts of the Tomsk and Yeniseisk governments, the region of Transbaikal and part of the government of Irkutsk, where the mineral wealth is but little inferior to that of the Urals and pos-

sesses all favourable qualifications for the extensive development of the mining industry. China will be a very near and valuable market for these districts as well as for other Siberian wares such as leather goods, furs et cetera. The opening of the Siberian railway will therefore enable Russia to profit by the proximity of China for the sale of its produce.

There is no occasion to dwell upon the political importance of the Great Siberian Railway. Its significance is clear from the fact that when the line is completed Russia will not only nominally but actually occupy that position in the east of Asia which it holds among its friends and enemies in Europe. As the line shortens the distance from European Russia to the east of Asia, in a like measure will the power of Russia increase in the East. In addition to this undisputed position, it may be mentioned that the favourable conditions already mentioned occurring from the opening of the line and extending commercial intercourse between Russia and the nations of the East, will undoubtedly conduce to strengthen friendly political relations with those countries. These friendly relations will be cemented by the mutual interests in the field of universal economic activity. Finally the opening of a railway line to the Pacific Ocean will enable Russia to carry on more direct intercourse with the United States of America, which in spite of being the great competitor of Russia in the grain trade of Europe, in consequence of the solidarity of its political and other interests, cherishes sincere sympathy for Russia.

THE

RUSSIAN STEPPES

STUDY OF THE SOIL IN RUSSIA,

ITS PAST AND PRESENT

by V. V. DOKUCHAEV, Professor

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PREFACE.

The wide expanses of the Russian steppes, with their peculiar climate, soil and vegetable and animal life, presenting as they do a very considerable general interest, must awaken a still more lively feeling in the United States of America, the greater part of whose territory is occupied with very analogous prairies.

In view of this, the Department of Agriculture and Rural Industry has considered it not unimportant, in supplement of the publication, «**Agriculture and Forestry in Russia**», for the World's Columbian Exposition at Chicago, to give a short sketch of the Russian steppe zone, its past and present, with the addition of an historical survey of the development of the study of the soils in Russia, a science which has latterly made great strides in this country.

Both articles, «**The Russian steppes**» and «**The study of the soil in Russia, its past and present**», are from the pen of Professor V. V. Dokuchaev of the St. Petersburg University.

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PART I.

CHAPTER I.

The last page in the geology of Russia in general and of the southern steppes in particular.

AS appears from a whole series of ancient and recent observations the Russian chernoziom steppes, in the character of their climate, contour and flora, as also probably their fauna, and partially as regards their ground and soils, form an inseparable part of that great steppe belt which almost uninterruptedly clothes the northern hemisphere, and into whose composition enter the Spanish desiertos, the Hungarian and Danubian pusty, the European-Russian and Siberian-Asiatic steppes, and finally the prairies of the United States of America. It is thus evident that to become acquainted with one link of this uninterrupted chain means to form a pretty distinct although general idea of the whole steppe belt of the globe, and it is therefore permissible for the present to stop at the Russian steppes. Nor is this all; till quite recently both foreign, and especially Russian men of science, divided our steppes sharply into three types: saline, occupying the south-east of Russia; chernoziom stretching some 300 to 400 versts to the north of the Black Sea and Sea of Azov; and the so-called forest steppe or fore-steppe, mainly in connection with the northern chernoziom boundary. The most important elements and features belonging to these three types of steppes may at times be found united within comparatively small spaces, without passing beyond the limits, for example, of one and the same government. Such for instance is the case with the government of Poltava, the geology, soils, arrangement of surface, water supply and flora of which have been in recent years subjected to comparatively very minute investigations. And therefore attention will here be specially directed to this government for the characterization and restoration of the Russian steppes.

As always, so in the most recent geological or post-tertiary period, the surface of eastern Europe was composed partly of dry land and partly of sea. But this period, the age of the mammoth, rhinoceros and prehistoric man, was also distinguished by its most characteristic peculiarity, the wonderfully extensive development of continental ice, and therefore received the name of the ice or glacial period.

In view of this it is evident that all the post-tertiary deposits of Russia, both on account of their general character and in particular on account of the manner of their origin and their animal remains, it is possible and indeed necessary to divide into

three types proper to three almost equal parts of Russia, genetically closely connected with one another: a. regions with marine or half-marine, half-freshwater deposits; b. regions of glacial formations; c. regions of purely subaerial and purely freshwater strata. Each of these falls, in its turn, into the following districts.

Districts of marine deposits.

The Northern, the basins of the lower course of the Pechora, Northern Dvina, et cetera; Aralo-Caspian, whose formations stretch in an uninterrupted zone, narrowing at the middle and to the north, eastward of the Ergeni and Volga, right up to the Kama, and perhaps still farther north; the Black Sea (this may be called the Scythian Sea) basin, its half-freshwater, half-salt formations situated along the northern shore of the Sea of Azov, and probably also along its eastern shore; Sivash, the Bay of Perekop, and further along the Black Sea, in the form of a ribbon very narrow in the east and visibly wider in the west. In the north the Scythian Sea was bounded partly by crystalline rocks and partly by more recent carboniferous and tertiary formations. To the type of these deposits, now occupying absolute altitudes of about 20 to 40 sagenes above the level of the sea, must be referred also, especially judging by their elevation, the formations of the Crimea.

Districts of glacial formations.

Timan, occupying almost the whole basin of the Pechora, especially its middle and upper course; Ural, hitherto ascertained only in the basin of the rivers Kosva, Chusovaya, et cetera; Caucasus, the present glaciers, only much enlarged; Scandinavo-Russian, the most extensive and the best explored.

Districts of continental formations *.

Otherwise, sections of the most ancient dry land in Russia, as regards soil and phytozoology; Ural district, western slope of the Ural ** and adjacent plains, right up to the limits, on the west, of the neighbouring glacial and Aralo-Caspian deposits; Volga, right nearest bank of the Volga (Penza and parts of the governments of Kazan, Simbirsk ***, Saratov) and Ergeni; Donets-Dnieper, a zone of dry land between the southern outskirts of the Scandinavo-Russian glacier and the northern boundaries of the ancient Scythian basin; Crimea and Northern Caucasus, free from glaciers.

To form a more exact and more real conception of all the types mentioned of the post-tertiary formations of Russia, it is necessary to examine one or two separate districts of each region.

It is most natural to begin such an investigation with the most extensive and interesting of them, namely the district of the great Scandinavo-Russian glacier.

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* Excluding, of course, glacial formations.

** Excluding the above named glacial island.

*** Perhaps, excluding one or two islands occupied by Aralo-Caspian deposits.

TYPES OF GLACIAL FORMATIONS.

As appears from the map of the Academician, Mr. Karpinsky, and from more recent works, the Scandinavo-Russian glacier covered with a continuous ice cap, probably not less than 300 to 1,000 metres in thickness, almost the whole of northern, three-fourths of central (in the west) and about half of purely steppe Russia. Judging mainly by the situation of northern erratic blocks, fragments of northern rocks, the extreme southern limits attained by it must be assumed to be, approximately of course, the river Styr in Volyn, the northern part of the Kherson and Ekaterinoslav and the south-eastern part of the Poltava governments, whence this boundary passes near the north-western corner of the government of Kharkov, to the eastward of Briansk, south of Sukhinichi, east of the town of Livny, to Pavlovsk in the Voronezh government and the mouth of the Buzuluk which falls into the Khoper. Hence the eastern edge of the erratic blocks ascends almost direct north, first along the right bank of the river Medvieditsa, then to Serdobsk, Saransk, and further to the Volga, which it intersects somewhat to the west of Vasilsursk.

If all the places indicated be united by a broken line, it will be clear that in the basins of the Dnieper and Don, principally their left tributaries, otherwise where the southern steppes become more or less depressed *, below 100 sagenes above sea level, the Scandinavo-Russian glacier projected far to the south, in the form of two wide tongues, of which the western, which fell a little short of 48° 5′ N. latitude, will be denominated in the present articles that of the Dnieper, and the eastern, not quite reaching 50° N. latitude, that of the Don. It follows that the Dnieper branch of the glacier advanced to the south, thanks partly to the less absolute heights, 150 versts further than the Don branch.

Between these glacier tongues arose a lofty plateau, now the watershed between the Desna and Dnieper on the one hand, and the Oka and Don on the other, occupying considerable part of the governments of Orel and Kharkov, the whole of Kursk and the western half of the government of Voronezh, a plateau that was never covered with ice. Another long but narrow strip of dry land stretching from north to south, bounded on the east by the Aralo-Caspian Sea, and on the west by the glacier mentioned, was formed by the lofty (over 100 sagenes) shore zone, now of the Volga but then of the sea, where are situated now the south-western part of the government of Kazan, the eastern part of that of Saratov, and almost all those of Penza and Simbirsk.

What traces have been left by the great Scandinavo-Russian glacier? Moving more than a thousand versts from the north-west to the south-east from Scandinavia, Finland and the government of Olonets to its southern and south-eastern, above indicated steppe limits, it destroyed, wore away, ground up, polished and partly sorted with the aid of glacial water, hundreds of every kind of rock, massive, stratified and other, granite, greenstone, limestone, marl, sandstone, clay et cetera, lying in its way, and transported their remains into more southern latitudes. Thanks to such a process lasting thousands of years, and thanks, on the other hand, to the chemical and physical alteration of the said rocks constantly continuing the whole time, there were necessarily

* The academicians, Mr. Tillo and Mr. Karpinsky, were the first to point out this important circumstance.

obtained the most heterogeneous products of glacial action which so far may be thrown into five groups or types: a. stony fragments of various rocks, often rounded, rarely even polished, the so-called erratic blocks *, large-grained sand et cetera; b. coarse, unsorted, unstratified, generally reddish-brown clay, almost universally in northern and central Russia employed for making bricks; c. well sorted, often fine-grained, for the most part quartzose, always irregularly stratified, variously coloured, mostly white or reddish sand; d. mechanically suspended mud, principally in the waters issuing from the glacier, perfectly analogous to that which even now is carried out in quantities from every glacier, and consisting of a fairly equal mixture of the minutest grains of quartz, flakes of clay, marly particles, et cetera; e. finally, substances, chemically dissolved in the glacial waters, as for example the most heterogeneous carbonates, sulphates, chlorides and other salts.

It may be positively asserted that all those types of glacial formations are inherent in every glacier of to-day. They also accompanied of course the great Scandinavo-Russian glacier in proportionately greater quantities, as its dimensions were more considerable than the ice fields of to-day.

Judging by the general character of the activity of every glacier it must be admitted that all the types here indicated of glacier formations must have been distributed over the area of the Scandinavo-Russian glacier far from uniformly. The coarser of them, transported with more difficulty by the water, naturally accumulated mainly in the northern and north-western portions, while the finer, easily stirred up and particularly soluble in water, were borne away further to the south and east, partly even beyond the limits of the ice cap. If the glacier had moved always over one and the same kind of rock and under the same climatic and orographical conditions; if a portion of the glacial, especially the chemical deposits had not already been carried away to sea; if finally the glacial agents were less heterogeneous, ice, water et cetera, then it were both possible and necessary to grant such an ideal distribution in Russia, in a direction from north-west to south-east, of the products of the Scandinavo-Russian glacier as follows.

I. Glacial pebbles, rubble, gravel and coarse sand; a quantity of glacial scorings, polished surfaces, furrowings of the continent, et cetera.

II. Most heterogeneous sands.

III. Coarse, unsorted brick clays.

IV. Formations of glacial mud.

V. Chemical deposits.

The number of erratic blocks and their dimensions, as a general rule, should diminish, moving from north-west to south-east.

But as the phenomena that took place in nature were much more complex, and not one of the above mentioned "ifs" wholly existed nor could exist, as finally in the life and activity of one glacier it is necessary to distinguish at least two stages, not reckoning temporary, may be periodical fluctuations in one or another direction backwards

* One of such granite blocks, having lost from artificial cutting about one-third of its mass, serves as the pedestal of the bronze statue of Peter the Great in St. Isaac Square in St. Petersburg. This guest from Finland, brought to us by the glacier was found in the Lakhta swamp in the neighbourhood of St. Petersburg.

and forwards, the advance and retreat of the glacier, stages separated from each other by thousands of years, at any rate for the more northern localities and which must have been accompanied in many respects by other processes and other products, it is then quite natural that the scheme indicated must have been infringed, it may be said, by thousands of the most heterogeneous departures.

Nevertheless a great number of exceedingly important data compel the admission that as a scheme, a rule, an expression of the vast majority of the phenomena, it is absolutely true, perfectly applicable to Russia, and probably to all other glacial countries, and in a position to help us in making out our extremely complex, and in fact very little studied, glacial formations.

And really, physically so to say, the whole immense region of the Scandinavo-Russian glacier falls perfectly naturally into the following zones:

a. The north-western zone of Russia, which includes all Finland and the neighbouring parts of the governments of Archangel, Olonets, Vologda, St. Petersburg, Novgorod, Esthonia and Pskov, with the White Sea, Gulf of Finland et cetera. The whole of this extensive region, especially Finland and the government of Olonets, presents an endless series of fields of erratic blocks, so-called hog-backs or ridges, composed ordinarily of coarse sands, gravel, glacial moraine and dust, erratic blocks, glacial scorings, rounded surfaces, roches moutonnées, cauldrons and a crowd of lakes and swamps.

b. The central non-chernoziom zone of Russia, consisting of the remainder of the governments just mentioned, the north-western half of that of Nizhni-Novgorod, all Kostroma, Yaroslav, Vladimir, Moscow, Vitebsk, Moghilev, Smolensk, and sections of the adjacent governments lying more to the west and south, et cetera. Here the following members of the glacial formations are more or less differentiated: 1. superficial, of no great thickness, sporadically occurring, non-stratified drift; 2. coarse, unsorted, very sandy, as a rule non-effervescent on addition of acid, reddish-brown brick clays, often with a quantity of northern erratic blocks; 3. sub-pebble, stratified, not unfrequently fine-grained sands, here and there with a pebble layer as foundation.

Often upon these formations, and at times in their interior, the latter, very rarely and only in the more southern parts of the given zone, are met with, always in small quantities, exceedingly finely ground clays and clayey layers, in some cases effervescing on the addition of acid, more seldom dark-tinted, containing organic matter and in some places indistinguishable from typical southern lösz.

c. The zone of lösz-like, more or less coarsely grained pebble, argillaceous rock, and of typical, fine-grained, perfectly homogeneous glacial lösz *; the former occupies mainly, although far from continuously, the more northern parts lying upon the so-called northern chernoziom border, comprising the corresponding portions of the governments of Nizhni-Novgorod, Vladimir, Tambov, Riazan, Kaluga, Tula, Orel, Chernigov, and districts further west; the latter, the more southern fringes of the said zone, projecting in places even beyond the ancient glacier.

It is obvious that all these zones of glacial formations pass into each other, so to say, melt into each other quite imperceptibly and very gradually, not seldom being inter-

* In the course of time when the limits of the lösz are more accurately ascertained, it will probably separate out into a distinct zone, although very ragged and interrupted.

rupted by and yielding to their neighbours, or themselves sending tongues or islands into them. Thus it has long been known that in moving from north to south in the zone of the northern chernoziom border, the typical glacial diluvium, consisting of reddish-brown coarse clays et cetera, becomes more frequent and more lösz-like, the number of erratic blocks and their dimensions diminish, the clays become more friable, more porous, the proportion of carbonates increases, the reddish-brown colour fades, and the lösz-like argillaceous rock gradually passes over, in places, into typical, porous, light-yellow lösz.

Such is the general character of the glacial formations in Russia. To become more nearly acquainted with their peculiarities in the Russian steppes, special attention may be directed to the government of Poltava and the Balashov district of the government of Saratov, which lie just on the extreme limits of the Scandinavo-Russian glacier, the former on its western Dnieper spur, and the latter upon the eastern or Don.

Little Russia in general and the government of Poltava in particular are clad with that beneficent lösz which feeds all China and our Turkestan, and appears as one of the best and most characteristic subsoils of the Russian chernoziom. Typical lösz is a marly, ordinarily unstratified, clayey soil, of a light yellow, sometimes straw-coloured hue, of a soft, even floury substance, extremely although finely porous, with a multitude of the very finest branching calcareous veins, tubules and incrustations, and at times nut-shaped concretions of the same material. On the whole it presents however a fairly compact mass separating, in natural sections on the inclined banks of rivers, the sides of gullies et cetera, into vertical fragments, pillars, towers, peaks, and at times other exceedingly quaint forms. Its chief constituent parts in the Poltava government are very fine grains of quartz, about 40 per cent, clay about 23 per cent, and carbonates about 11 per cent or maximum 13·5 per cent.

Such a lösz clothes continuously all the plateaux forming the watersheds of the government of Poltava, with a layer not less than three sagenes in thickness. Only in the eastern third of the Konstantinograd district, partly in the districts of Zienkov and Kremenchug, et cetera, it becomes evidently coarser, contains a greater proportion of grains of sand and loses its porosity. A still more sandy character belongs to those lösz-like rocks which lie on almost all gentle slopes, especially in their lower half, in the valleys of rivers and streams. Of organic fossil remains, besides the carbonized particles of herbaceous vegetation, here are found exclusively shells of terrestrial and semi-paludinal mollusks, bones of typical steppe rodents, and more seldom, portions of the skeleton of the beaver, mammoth, and the usual companions of the latter.

Only quite recently has the extraordinarily important fact been positively ascertained, of the occurrence, in the Kobeliaki and Priluki districts, in the lower beds of the typical lösz, of undoubtedly erratic blocks. Besides this there is often found in it, as in the districts of Kobeliaki, Lubny, Khorol, Mirgorod, Priluki, Zolotonosha, Lokhvitsa, and particularly Kremenchug, a dark gray rock, much coarser than the lösz itself, rich in quartz grains, sometimes effervescing on the addition of acid, sometimes not, one to seven feet in thickness; it contains from 1 to 3 per cent of humus. Here and there it is broken by small cracks, in the walls of which and sometimes in rather large pores, are deposited whitish formations of carbonates. In places there appears a quantity of ruddy, reddish-brown or bluish gray spots, perfectly analogous with those which are so characteristic for marsh land; it is seldom stratified. In some cases it forms a

fairly continuous and definite bed; in others it gradually mingles with the neighbouring lösz, giving it and receiving from it irregular patches, tongues, veins, et cetera. In Khmielov, in the Romny district, a mammoth tusk was found in it.

This curious rock, considered formerly at one time to be humous lösz at another ancient chernoziom, has now been discovered in the midst also of typical drift formations, wherefore among other reasons it should be referred to them, being evidently formations of snow-field (firn) and glacier mud, rich in organic matter.

It is extraordinarily instructive that in the Konstantinograd district such a rock is not to be met with at all, while in the Poltava and Zienkov districts it is found only in the drift regions or near to their very limits. It is clear then that the Poltava lösz as also all typical Russian lösz must, as Professor Inostrantsev affirms, be referred to glacial formations.

But once this is so, once the glacier retreated on the whole from south to north, which is a matter of no doubt, the conclusion follows at once that the southern and south-eastern districts of the government of Poltava are older than the rest in relation to soil and phytozoology. Almost everywhere in the government of Poltava, that is, on the watersheds, immediately under the lösz, lie brown, somewhat coarse clays, often marly and more or less lösz-like. They in many places contain spring waters. With the very characteristic exception of the districts of Konstantinograd, Zienkov, and the eastern half of the Poltava district, these clays in all the rest of the government constantly contain pebbles; their thickness is about one and a half sagenes on an average. In places, for example in the Kobeliaki, Khorol and other districts, they are evidently replaced by sands, containing mollusks, many of which are indeed common to the lösz and the so-called freshwater marls (see below), and in places, for example in the districts of Gadiach and Priluki, by a rock with difficulty distinguishable from lösz. Precisely in this bed there have been found in the Khorol district mammoth's bones, stag horns, and the perfect skull of a s u r o k (arctomys bobac). It is necessary to add that here and there in typical drift clay (Gadiach district) and between it and freshwater marl (Zolotonosha district), lies precisely the same dark gray rock, consisting of snow-field (firn) and glacier mud, as in the lower part of the lösz, sometimes even with erratic blocks.

The lowest bed of post-tertiary formations in the government of Poltava is composed of fine-grained, sometimes even floury, ordinarily stratified marl, of a predominating bluish-gray colour, with ochreous stains, six and more sagenes in thickness. It was already proved by Professors Borisiak, Armashevsky and Gurov that, judging by the fauna, this is typical freshwater marl, and by the last, that it is entirely absent from the Konstantinograd district. The most recent investigators have added the following curious facts. In the districts of Kremenchug, Kobeliaki, Khorol, Lokhvitsa, and probably here and there in others also, the freshwater marls are swarming with small, usually much weathered, erratic blocks, and in the districts of Gadiach, Lubny, Kobeliaki et cetera, they are here and there replaced by exceedingly fine-grained, highly marly, sometimes extraordinarily stratified sands. In the neighbourhood of Balaklaya in the Khorol district, and Leschinovka in the Kobeliaki district this pebble marl is traversed by a very ragged bed of humus. Below this in Balaklaya the author observed further dark brown, round stains with difficulty distinguishable from k r o t o v i n a s or the burrows and passages of existing and extinct rodents filled up with earth. Near Leschinovka in the glacial mud itself was found a mammoth's tusk, while remains of the same

antediluvian animal have been discovered also in the normal freshwater marl, near Antsibor farm in the Romny district.

In concluding the discription of the drifts of the Poltava government it is not superfluous to remark that, judging by the composition of the spring waters which for the most part occur within the pebble formations, and also by the mass of salines, it is necessary to admit the existence in the said rocks not only of carbonates but also of chlorides and sulphates, although in infinitely small quantities and not universally.

Such is the scheme of the post-tertiary formations of the centre of Little Russia, below which in the government of Poltava follow varicoloured modelling clays, bearing a second water bed, white sands and glauconite rocks, in which a third bed of springs, the most constant and powerful in the government is contained. Not a few cases are known of the passage of these post-tertiary rocks into each other, such as the lying of freshwater marls in the bed of the reddish brown clays, and the occurrence of lösz under typical drift formations. Both in view of this densest stratum and the petrographic connection between lösz proper, drift clay and freshwater marl, and from the erratic blocks contained in them and the fauna, all these formations should be referred to one and the same series of quaternary drift formations deposited on the edges of the great Scandinavo-Russian glacier, partly in front of it, partly under it, and partly behind the retreating ice cap.

The whole difference, which can so far be actually established between them, consists in the more precise and almost constant stratification of the marl and the somewhat more aqueous character of its fauna, in the non-stratification and porosity of the lösz and its more terrestrial fauna. Hence it is necessary of course to conclude that the first was formed mainly in some probably stagnant basins or other and the second upon dry land clothed with steppe and in some places with marsh vegetation, principally during the glacier inundations. The latter, like our spring steppe, bankless torrents upon the watersheds, inundated immense areas and deposited their mud, as it is even now deposited, over the meadows and washes of our rivers. It is instructive that upon our river washes, also clothed with herbaceous vegetation, there is sometimes deposited an absolutely unstratified mud, or it loses finally all trace of its stratified composition. Such specimens are in the collection of the St. Petersburg University and prove to be very porous. It is very possible that the formation of lösz belongs mainly to the period of the decisive and final retreat of the glacier, and consequently it was accompanied perhaps by a certain rise of temperature and increase of various sorts of vegetation.

Moreover those basins also, where freshwater marl was deposited, were probably shallow with standing water not seldom half swampy and sometimes even temporary. It must not be forgotten that typically aqueous forms are yet few in the marl, and if not everywhere still in many places it is threaded with minute root-shaped passages, sometimes with carbonized vegetable remains. Into some of such lakes then flowed, and that not constantly but mainly in winter and spring, the more gentle streams and rivulets carrying down exclusively fine mud, while into others there flowed raging torrents, and it may be, separate branches of the glacier itself transporting besides fine glacial mud, also small rolled stones and pebbles.

The reddish-brown clays are probably formations of the glacier itself, as it were intermediate in character both by their composition and mode of origin between lösz and freshwater marls.

From the given point of view and having in mind the masses of half-organic dust and mud even now being formed upon the firn, or snow-fields (Ratzel) and ice fields in the Alps, Siberia et cetera, it is easy to understand the formations also of the so-called humous lösz and its occurrence not only in all the quaternary formations of the government of Poltava but probably although sporadically in the drift formations of all Russia. Having regard to the far from sufficient actual acquaintance with the contemporary activity of the glaciers of the type of Greenland, and the still not completely detailed investigation of the Poltava drifts, to enter into further minutiæ in respect to the origin of the formations under consideration would be premature.

Unfortunately the boulder drifts of the eastern or Don wing are far from appearing with the same precision. The principal result of the fragmentary data of the literature of the south-eastern limit of the boulders is cited above. From the same source it is known that the drift itself is here composed mainly of brownish gray and reddish-brown, sandy, clayey soils, which from their general character, sometimes their porosity and large proportion of carbonates and comparatively rare occurrence of boulders deserve to be called boulder lösz-like clayey soil, as was done already in 1883. The latest investigations have divided the boulder drifts of the Balashov district into the following types.

Immediately under the chernoziom, chiefly in the somewhat depressed parts of the high steppes lies a chestnut-gray, coarse sandy, slightly porous clayey soil with a quantity of sharply defined calcareous veins and kernels. In rather large and fresh sections may be distinguished separate variously coloured beds, and sometimes the very thinnest layers of small marly, rounded fragments. Of itself the said clayey soil is not stratified. As a great rarity small northern boulders occur in it, and occasionally plates of plaster of Paris. Its depth attains one to three sagenes.

Deeper lies usually a still coarser, light red, highly sandy, unstratified boulder clay, actually very close to its northern representatives. In it there is a crowd of erratic blocks; it effervesces briskly with acids and contains a quantity of coarse, calcareous incrustations and pieces. Its thickness is from one to two sagenes.

The ground bed of the boulder formations is composed of an almost white, coarse, very sandy, unstratified, marly, clayey soil, crowded with a mass of much rolled local stones, those from the north being met with as an exceptional rarity. Its thickness is from two to three sagenes.

While concluding with this the formations of the great Scandinavo-Russian glacier, it is necessary to state that, judging by the character and conditions of formation of the most superficial glacial deposits, namely on its southern limits, judging in the next place by the virgin Saratov, Voronezh and Poltava steppes, yet here and there existent, the primitive surface of the lösz and analogous districts was distinguished by remarkable levelness.

TYPES OF MARINE DEPOSITS.

As regards the so-called Aralo-Caspian formations, once lying mainly all along the left bank of the Volga to the Kama and perhaps further north, they have been already more than once described both in special and popular works. Accordingly it is sufficient here to remark that these deposits, with a fauna existing to this day in the

Caspian Sea, sands, clays, marls et cetera, often saline or bitter, not seldom containing gypsum, also serve as one of the commonest subsoils of the chernoziom and chestnut-coloured soils of the south-east of Russia.

Such are the formations of the immediate neighbourhood of Samara, where they are represented by brown and bluish gray, stratified marls containing cardium edule. From their general appearance they are scarcely distinguishable from several Poltava freshwater marls, and support most excellent chernoziom with 11·5 per cent humus, evidently much better than that which lies on the neighbouring, incomparably older rocks. It follows that this furnishes one more proof that the growth of soil is measured by an essentially different standard than that of geology. Not less characteristic is it that in the same locality of Samara, as evidently everywhere in the European district of the Aralo-Caspian, there is no trace of more or less typical lösz. For us incomparably more interest is presented by those deposits which were formed in the ancient Scythian basin, otherwise in the more or less narrow zone adjacent to the present Sea of Azov, Sivash, Bay of Perekop, and further along the northern Black Sea shore.

According to the investigations of Mr. Sokolov, on the surface immediately under the chernoziom here lies a yellow-brown, clayey earth very like in general appearance to lösz, possessing a porous structure and a tendency to form vertical cleavages. Its sole essential distinction from typical lösz is the abundance of salt and gypsum, which in the form of minute crystals in some places literally penetrates the rock through and through. Further, what is very characteristic, the edges, angles and planes of the crystals are distinguished by complete preservation. In accordance with such resemblance between fresh and salt lösz the author ascribes to them one and the same subaerial mode of origin.

Deeper down almost everywhere follow homogeneous unstratified, reddish brown and greenish gray clays, with vertical cleavage, more or less rich in gypsum and salt. Besides the very rarely occurring bones of small land mammals, no other remains have been found in them.

To the east of Nogaisk, for example, between that town and Berdiansk, near Mariupol, Taganrog, and probably Novocherkask, under the clays mentioned, Mr. Sokolov succeeded in showing the existence of ordinarily large-grained, gray and brownish stratified sands, as much as fifteen metres thick, with interposed layers of small rounded stones and more rarely greenish blue clay in plates. In them, although rarely, are found the shells of freshwater now living mollusks (unios, cyclas, bythinia, paludina), and the bones of such mammals as elinaceus Europaeus L., spermophilus aff. mugosaricus Br. myodes lagurus, arvicola amphibius Blas., the mammoth and elephas sp.

Evidently, similar sandy formations lie below the reddish-brown clays, but above the pontic limestone, and to the west of the Dnieper, namely near Ochakov, along the Berezansk firth and on the island of Berezan.

Besides these deposits, evidently from flowing water, Mr. Sokolov observed in the northern part of the Tauride government and the east of that of Kherson, as well as in the Novo-Moskovsk district, further very fine-grained, marly formations of standing lake and sometimes marsh waters with remains of planorbis, limnea, succinea, vallonia, pupa, buliminus et cetera. But sometimes there happens among these formations an evidently typical lösz with exclusively land shells. At any rate such a highly instructive fact was demonstrated by the above-named man of science near the colony of Prishib on the

river Molochnaya. All these formations are covered either with lösz or reddish-brown and greenish gray clays.

Comparing the geographical situation of the said sandy deposits near Taganrog and Novocherkask on the one hand, and of the Berezansk firth on the other, with the already described Dnieper and Don glacier tongues, Mr. Sokolov comes to the following very just conclusion: «It is exceedingly probable», says he, «that in direct continuation of these southward projecting capes of the ice cap were formed collections of water from the melting of the masses of ice, and that to these streams of freshwater is due the formation of great thicknesses of freshwater, sandy and pebbly deposits, occurring on the northern shores of the Sea of Azov and the Black Sea». This author further adds: «From the western Dnieper cape of the ice cap the flow of freshwater was partly directed almost straight south to the firths of the Dnieper, Bug and Berezan, and partly the water flowed, in all probability, in the valley of the Dnieper. The streams formed from the melting of the ice of the eastern Don cape must have turned the eminence of the Donets ridge by the east».

Types of formations of the old dryland.

But what took place at that time over those areas of dryland which were not occupied either by sea or glaciers?

All the superficial formations (ground, not soil) such as most heterogeneous clayey earths, clays, sands, marls, clothing these regions, belong exclusively to eluvial formations in particular and to products of weathering in general, deluvial or rain alluvium, alluvium either riverine or lacustrine, and aeolian, mainly dune formations. Of course these formations are also met with in regions where formerly there was sea or glacier, but they do not there give the character to the ground. The first of them, the products of weathering in general, of themselves not stratified, frequently when produced from limestones, chalk, marls et cetera, are lösz-like, and lie principally upon the watersheds and rarely reach any considerable thickness, usually less than a sagene, gradually passing into the rocks lying beneath. Similar formations occur sporadically everywhere upon all kinds of bed rocks.

Rain alluvium, almost always irregularly but often finely stratified, covers with a thick layer, to seven and more sagenes, those most heterogeneous slopes and depressions, where there are not now and never were permanent water basins. In character it is often hard to distinguish from typical lösz. The loci classici for gulley alluvium are the neighbourhood of Saratov, as also of Nizhni-Novgorod and N. Senzhar lying on the Vorskla, outside the region of typical boulder formations.

River and lacustrine, old and new, ordinarily stratified alluvium, as is shown by its name, fills up the lacustrine and riverine depressions and sometimes contains the bones of the mammoth and rhinoceros and often a mass of vegetable remains of such forms as now no longer exist in the given locality.

Finally, aeolian formations are mainly the most heterogeneous dune-like hills along the shores of water basins at present existing and long since extinct, the favourite haunts of prehistoric man.

Such are the usual and sole ground beds of all the most important regions of the ancient Russian dryland.

So far one, but that an exceedingly interesting exception is known, pointed out by Mr. Sokolov. To the north and partly to the south of the parallel of Melitopol, on both of the ancient banks of the Dnieper, beyond the river valley lies a light yellow rock having all the characteristics of typical glacier lösz. It is very soft to the touch, clayey, sandy, rich in lime, riddled with pores, unstratified, with clearly expressed vertical cleavage. Such exactly is that lösz which is met with upon the tops of the gulleys penetrating far into the high steppe.

Here occur, although rarely, exclusively land mollusks and remains of the marmot, mammoth, et cetera. It must be supposed that this is the direct continuation of the Poltava lösz, namely its Kobeliaki branch. It is very possible that such tongues of lösz will be discovered also in the lower course of the Don, to the south of and deeper than the boulder formations of the governments of Saratov and Voronezh.

It has been already observed above that the three great regions into which Russia fell in the very beginning of the quaternary period in the sight of prehistoric man, are connected together genetically in all the most important stages and phenomena of their geological and probably all other life. The following are the main bases of this thesis.

The Academician, Mr. Karpinsky, in his article, «Sketch of the physico-geographical conditions of European Russia during past geological ages» observes among other things: «It may be that the maintenance of the high level of the Caspian and the wide extent of the Aralo-Caspian basin connected therewith were caused by the same humidity or abundant precipitation, without which the development of glaciers could not take place. The greater part of the water flowing from the melting glacier must have proceeded into the basin in question». Fully accepting the idea of the simultaneity of the existence in Russia of the Scandinavo-Russian glacier and of the Aralo-Caspian sea and of the close connection between these grand phenomena with the life of our country, it must yet be admitted that the greater part of the glacial waters could not have flowed together into the basin mentioned. And as a matter of fact it is enough to call to mind the southern limits of the glacier, especially its Don and Dnieper wings; it is enough to take a rapid glance at the map of the extension of the Aralo-Caspian and of the former ice-cap, to see the necessity of sending the greater part of the waters of the Scandinavo-Russian glacier, not to the east but to the south, not to the half-Asiatic Aralo-Caspian but to the European Black Sea, whither flowed evidently not only the Don and Dnieper glacial torrents but perhaps also the Dniester-Bug and other streams. And if this was so, at any rate at the very height of glacial activity in Russia, it is natural that the Black Sea, even then half of the Aralo-Caspian, could not like the latter escape raising its level, the more so that in the very beginning of the quaternary period it was such a closed sea as is the Caspian now. Such an overflowing of the Russo-Scythian basin with glacial waters might carry in its train in the first place the breaking through of the Bosphorus and the uniting of the Black Sea with the Mediterranean; in the second, the direct (although by a very narrow strait) union of the Black and Caspian seas; and thirdly, the formation of those greenish gray, reddish brown, and lösz-like yellow-brown saline clays which on the shores of the Sea of Azov, Sivash et cetera, still cover sand deposits evidently connected with the glacial rivers. Then also at the time of such union, although lasting

but a short time, of the Mediterranean, Black and Caspian seas, animal forms of various kinds could have migrated from one to the other, which evidently took place in fact. It is very possible that approximately at the same time in the post-tertiary period there existed the Pechora and Dvina gulfs.

To make such a guess at the contemporary existence of all the marine quaternary formations of Russia with the Great Scandinavo-Russian glacier, is the more permissible that all the separate regions with marine deposits occupy in Russia some of the most depressed spots, whose absolute level very rarely reaches sixty sagenes but commonly falls much lower. Accordingly, if the continent of Russia were to sink to the extent mentioned the said regions would again be under water. Such a supposition is the more natural that the sea preceding the Scythian sea went much further into the interior of the southern steppes than the saline clays, clothing the sands of the glacial torrents.

Further, such an assumption yields a ready explanation of that «humidity of the air and abundance of precipitation, without which the development of glaciers could not take place». Finally, the most recent elevation of the continent of Russia, most probably coinciding with the beginning of the retreat of the glacier, being actually proved for several parts of the shore of the Gulf of Finland for the northern, and perhaps also for the southern littoral regions, affords a perfectly natural explanation of the present disposition of the marine quaternary deposits, namely the undoubted drying up of the southern and especially south-eastern basins of Russia, and the decisive retreat and melting away of the glacier, which together with the most recent formation of the system of river valleys and ravines, carried in its train the further impoverishment as respects water of not only southern but northern Russia.

True, already under the present conditions of the contour of Russia, and the present really inconsiderable difference in the absolute heights of northern Scandinavia and especially Finland on the one hand, and the eastern European plain on the other, it is difficult to understand the movement of the glacier with a front of over 1,000 versts from north-west to south-east, being at the same time obliged in places to pass through considerable depressions, such as the gulfs of Bothnia and Finland, the lakes Onega and Ladoga, and others.

This objection is however easily removed. Supposing a general depression of the whole of Russia by 30 to 60 sagenes, the relative elevations of its separate parts will of course not be changed, and they it is that play the most prominent part in the movement of the glacier. Besides this, assuming the whole thickness of the glacial drifts of Russia lying to the south and south-east of a line drawn through the Gulf of Finland, lakes Ladoga and Onega and the White Sea equal on an average to ten sagenes, and assuming Finland and the neighbouring part of the Olonets government to be uniformly covered with them, the two latter territories would be raised by about thirty-three sagenes. Of course, approximately speaking, one-half of the whole quantity of our drifts is of local origin, but on the other hand, if not all yet very many points of central Russia were before the formation of the glacial deposits undoubtedly lower, in other words, the glacial formations indisputably raised them.

The deduction from all that has been said is that before the arrival of the glacial period the difference in the relative altitudes of the north-west and the centre of Russia was at any rate more considerable than now. It is even possible that the more energetic

although gradual paring down by the glacier of the original, superficial rocks principally of north-western Russia brought in its train a slacking of the aggressive capacity of the glacier, which, besides ever more and more encumbering its road with its own deposits, here and there becoming very thick towards the south, naturally grew weak and became incapable of carrying off even friable, at times exceedingly thin layered freshwater marls, as in the government of Poltava.

CHAPTER II.

Arrangement of the surface and water in the Russian steppes.

JUDGING by the conditions of the formation of the south-Russian lösz and the neighbouring marine post-tertiary formations, the Russian steppes must have offered in the first period of their existence endless plains with incomplete hollows and closed cups. The vast majority of the present rivers and gullies did not as yet exist. On the other hand there were probably many temporary swamps and lakes, essentially different, however, from the type of those in the north, belonging mainly to the north-west of the glacial region. As the most obvious example for all this, may serve the government of Poltava. As is well known, that government extends 300 to 350 versts from north-west to south-east along the left bank of the Dnieper in the form of a strip from 150 to 200 versts broad. Judging by the direction of its chief rivers, the Vorskla, Sula and Psiol, and in particular from the data of A. A. Tillo's hypsometrical map, it appears that all this zone falls with remarkable uniformity from east to west, from the neighbouring government of Kharkov in the direction of the Dnieper. Thus in the districts of Romny, Gadiach, Zienkov, and Konstantinograd, conterminous with the government of Kharkov, the prevailing elevations are equal to 80 to 89 sagenes above sea level, and only individual islands reach 90 to 99 sagenes. To the south-west of this are situated first the districts of Priluki, Lokhvitsa, Mirgorod and Poltava, the latter partly conterminous with the government of Kharkov, where localities prevail with an elevation of 70 to 79 sagenes, and then those of Pereyaslavl and Khorol, 60 to 69 sagenes, and Piriatin and Lubny, 50 to 59 sagenes. Finally, still nearer to the Dnieper, are the districts of Zolotonosha, Kremenchug and Kobeliaki, in which the greater part of the localities have an absolute height of 40 to 52 sagenes, the washes of the Dnieper probably not being higher than 30 to 40 sagenes.

It is very instructive that the levelness of a locality is in inverse proportion to the absolute height. The highest districts, Romny, the greater part of Gadiach and Zienkov, almost all Lokhvitsa, the eastern half of Priluki, Lubny and individual portions of Konstantinograd and Mirgorod are scored with rather deep river valleys and covered with a quantity of at times exceedingly ramified gullies and ravines. More or

less hilly spots probably there as here even predominate over level spots. On the other hand the western halves of Priluki, Lubny and Konstantinograd, separate portions of Mirgorod and a great part of the Poltava districts offer a region of boundless steppes where plains perfectly level to the eye stretch not unfrequently to the horizon. And this distinctive feature becomes still more considerable in proportion as the Dnieper washes are approached. The greater part of the districts of Pereyaslavl and Kremenchug, especially of that of Piriatin and Zolotonosha, of the southern half of Khorol, and of a very considerable part of Kobeliaki may be called ideal steppe. Here the locality becomes elevated exclusively on the right hilly banks of the Vorskla, Psiol, Khorol, Sula, Udai and their chief tributaries.

In both halves of the government of Poltava, in both its more elevated and depressed districts, the same forms of surface are repeated, with wonderful uniformity and constancy, and in the same order. The whole difference is only in the extent of the forms.

The fact is that the northern section of the Dnieper, for the government of Poltava, the rivers Supoi, a tributary of the Dnieper, Udai, Sula, Khorol a tributary of the Psiol, the Psiol, Vorskla, Orchik and Berestovaya, a tributary of the Orel, divide the whole government into nine watershed areas arranged as follows: a. the high hilly right bank of the river, Psiol, Sula, et cetera; b. the interriverine steppe plateau; c. the gentle incline to the neighbouring river terminating as a rule with one or two offsets or more rarely sand dunes; d. the washes, individual sections of which are sometimes not covered by spring floods; e. the river with its ancient beds. In the same way the left bank of the Dnieper also is arranged, only here the gentle inclines to the neighbouring river and the washes attain relatively much larger dimensions.

If it be added that into the composition of almost all the watersheds enter the very same rocks, lösz, drift clay, freshwater marl, et cetera, that they form the high right banks of almost all the Poltava rivers, that of them are built the walls of the vast majority of the deepest gullies and ravines, it follows that immediately after the deposit of the lösz, and the formations parallel to it, the whole of the government of Poltava actually presented a continuous level steppe similar to those which are still preserved in places in the districts near the Dnieper. This steppe fell gently in the direction of the Dnieper depression which undoubtedly is much older than the remaining river valleys of the locality under consideration. It must be supposed that the depression of the Dnieper existed earlier than the arrival of the glacier, which precisely on this account spread here further to the south, but afterwards probably itself contributed to the further deepening of its bed perhaps annihilating on the road the varicoloured clays and part of the white sands almost everywhere in the Dnieper districts. As is known to the author from personal observations there are very few exceptions.

In the same direction from north-east to south-west, approximately on the site of the present valleys of the Vorskla, Sula, Psiol, et cetera, there then stretched, probably with unimportant and incomplete breaks, wide, gently sloping, entirely unformed depressed strips of steppes over which flowed at first the remains of the glacial water, and afterwards spring and rain torrents.

These primitive, bankless hollows, as they may be called, owing their origin exclusively to the geological structure of the locality in question, may be best of all compared with those depressed portions of the steppes by which even to the present day

in the complete absence of ravines, gullies and river valleys flow together the superficial waters in many parts of the districts of Pereyaslavl, Khorol, Lubny, Priluki, Piriatin and Zolotonosha. One of such steppe depressions extends in the district of Piriatin 55 versts long and 25 broad. Similar depressions, often quite imperceptible to the eye, occur among the steppes of the Chernigov government and in particular in the Balashov district of the Saratov government. There is no doubt but that they exist or did exist in all the other virgin steppes also, alike in Russia and other countries. Some of those primitive depressions are almost entirely cut off, at any rate for ordinary, not very heavy atmospheric precipitations, and form the favourite situation of salt-marshes and temporary lakes. A number of such lake pools, often assuming quaint forms and of very considerable dimensions but only lasting a few days, may be seen in any virgin steppe after heavy rains, especially in spring or autumn. Others, through a series of hollows forming a chain, are united with river valleys, not unfrequently thus acting as their source. It was depressions of this type, usually of a rounded form, finally communicating with river valleys, that were evidently observed by Professor Levakovsky among other places in the districts of Kharkov, Sumy and Akhtyr. Some of them to the present time have but little altered their original appearance, containing such quite incomplete stream-marshes as the Slieporod, Orzhitsa, Zolotonosha and others. Yet others have to-day left no trace.

Thanks mainly to more considerable absolute elevations, and also to the greater age of the given locality, some of the hollows mentioned have long ago become covered with a system of ravines transformed in the course of ages, here into wide gulleys and there even into actual river valleys, entering into the bed rock of the Poltava government in places as much as 30 or more sagenes.

How these ravines began, how they grew and took shape, how some of them became transformed into gulleys and rivers, all this has been examined in detail by the author in a special work under the title, «Means of formation of the river valleys of European Russia». There also with sufficient minuteness is explained the precise way in which were elaborated those forms of river valleys by which among others all the rivers of Poltava are characterized. Therefore here attention may be directed exclusively to the circumstance, ordinarily little noticed, that river valleys, now having a depth of tens of sagenes and a breadth measured by versts, did not appear all at once. There was a time when the river bed was only just beginning to form, when its bottom was in turn lösz, red boulder clay, freshwater marls, and only then varicoloured clays, and finally white and green sands with glauconite clays. Evidently at that time the surfaces of the river waters must have been consecutively on a level with all the geological formations just mentioned.

For a specialist in geology it is enough to glance at the form of the river valleys of the Russian plain, their depth, breadth, and particularly their riverside terraces, to become convinced of the inevitableness of just this order in their development. Nevertheless it will not be superfluous to bring forward here one or two facts that may make the matter clear even to a layman.

Thus, in the immediate neighbourhood of the celebrated Nenasytets cataract on the Dnieper, on the right bank of the latter, at a height of about three to four sagenes above the mean level of the river, may be seen splendidly preserved rocks of granite and gneiss, extraordinarily strongly water worn, and bearing gigantic blocks of the same

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rock equally well rounded both on the upper and the lower surface, and sometimes resting on merely one or a few inconsiderable points. Such their situation and form, perfectly analogous with the blocks lying in the abyss of Nenasytets, indisputably point to another but likewise more or less constant level of the waters of the Dnieper, to another much higher level of the Nenasytets cataract. There too, and also at a height of two to three sagenes, there is still preserved a layer of coarse sand with worn and even polished granite fragments and similar blocks two or more feet in diameter. Of course the layer in question, undoubtedly riverine, could form only at another much higher level of the Dnieper waters, long before the existence of the Camp of Transcataract Cossacks, or even the campaigns of Oleg against Tsargrad. As early as 1885, Professor Gurov discovered in the neighbourhood of the village of Bogachka in the district of Mirgorod, in a special depression of the right or hilly bank of the Psiol, a bed of thick freshwater deposits containing remains of fish and a number of freshwater shells. The same incontrovertible witnesses of another higher level of the waters of the Psiol were investigated by the author during an excursion in the summer of 1891 to a height of three to four sagenes above the present washes of the same river.

In the hamlet of N. Senzhary in the district of Kobeliaki, upon the Vorskla, there lean against the high abrupt bank of this river, seven to ten sagenes above the limits of the present spring floods, thick formations of the so-called rain alluvium which undoubtedly occupy the place of the former valley of the Vorskla which evidently then had another level and other dimensions. But to repeat, the most convincing and manifest proof of the former higher levels of the river is the universally occurring river terrasses, usually three but sometimes more, almost always disposed with offsets along the left gently sloping banks of our rivers.

And thus it appears that there was a time when the level of the Dnieper, Vorskla, Psiol, Sula, Udai and other rivers, stood higher than at present by tens of sagenes, when the whole of their bed, after the fashion of the present Slieporod, Orzhitsa, Perevod, Zolotonosha, Irklei and others, lay in the lösz, rarely cutting through the typical boulder clays, when their bed was not composed of green and white quartz sands as now, but of dense freshwater marls and still more plastic varicoloured clays. And all this could but have as an inevitable consequence a higher level of the soil waters in the government of Poltava and a greater abundance of them in general.

But it is obvious that the deepening alone was far from causing the lowering of the soil waters. At the same time, beside the deepening of the river valleys, went on the immoderate, so to say, quite unnecessary for the summer stream, broadening of them, measured sometimes by versts and tens of versts, the bed, in the case of a river of average size, being ten, or more rarely, several tens of sagenes wide. And as both the deepening and the widening, if not always at any rate in many cases, brought in its train the encumbering of the bed, especially in its lower reaches, by various kinds of drifts, the consequence was an inevitable diminution in the swiftness of the stream. The latter began to flow in a crooked line in zigzags instead of straight, became divided at first into separate feeble arms and then into isolated lakes and marshes, which again became a river only during the brief floods. In consequence of all this the area of evaporation and filtration of course increases and the life of the river little by little completely expires, although the annual quantity of atmospheric precipitation remains the same as before.

But if all this beyond any doubt occurs everywhere even in our far north, the dimensions of the phenomenon in the south of Russia are particularly great. And as a matter of fact, if anything strikes the naturalist in Little Russia, it is the abnormally broad river valleys, with the insignificant ribbons of water sometimes so thin as to be broken at every step. Such for example are the Goltva, Orzhitsa, Slieporod, even the Udai and the vast majority of the other rivers. And there is no doubt but that the most important causes of this phenomenon are the peculiarly heavy spring and summer floods in the steppes and the extreme capacity for denudation of the local lösz.

And yet it must be observed that far from all the Little Russia rivers and streams can actually boast of their flourishing past, the strength, power and energy of their youth. Many of them probably never had anything of the kind, had neither infancy, youth nor manhood. They were born with the feebleness of age, they never had the strength to cut themselves a bed even through lösz, they do not possess as a matter of fact their own bed and fixed banks, their own habitation, they formerly enjoyed and till now are satisfied with those ready made cups, hollows and dimples which were left by the glacier, and only made them more swampy. If in the case of these youthful veterans there may be observed at times for considerable distances somewhat high and even perpendicular banks, it is not to be forgotten that first such pseudo river terraces occur here and there also among perfectly dry steppe plains, where there can be no question of any permanent water basins, and secondly, that small streams and steppe depressions in general, during spring and sometimes summer inundations, not confirmed by definite banks, foam and bubble, not less than such rivers as the Vorskla, Psiol and Sula. Why then may not they in the course of centuries and millennia wash away the obstacles of lösz met with in their path and form for themselves, even if it be only for appearance, river banks.

If in the Stugna, Trubezh, Orzhitsa, Alta, Supoi and Perevod, remains of large vessels and large appliances belonging to ships have really been found, it is necessary to remember two things. First, according to Professor Levakovsky, the remains of these vessels might be the result of an unsuccessful floating of them during the spring inundations. «Similar floatings», says he, «were attempted as late as the fifties down the Donets from the forest plantations of the Izium district where sea-going coasting vessels were built and were despatched to Taganrog for sale. It occasionally happened that they did not succeed in reaching their destination before the fall of the flood, or sat on a shoal». Such facts are known to every one from whatever part of Russia. Secondly, such phenomena must not be confounded, which is however constantly done, as the ceasing of river navigation and actual shoaling, phenomena which in nine-tenths of the cases have nothing in common.

In a word, if it is desirable to decide the question exactly whether it is a dying river or one that never enjoyed actual life, it is necessary to study more nearly and with greater attention the contour and geological structure of its valley. But in any case both types of river veterans exist in the steppes, and accordingly cannot but testify to a certain disorganization, albeit perfectly natural, of the water economy of southern Russia.

And it will be the easier and the quicker to make such a deduction, that with another, and in certain cases, higher standing level of the river waters, the system of ravines and their depth were of course less considerable than now. But what

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a mighty influence these natural drainage pipes have upon the drying up of a locality, has been long explained *, although excavations of various kinds help in some cases the issue of springs upon the surface. It here suffices to repeat that with the development of ravines the evaporating surface of a given locality is increased. Spring and rain waters flow much more rapidly off the steppe into the depressions, in consequence of which the quantity of moisture entering the soil diminishes, and this must inevitably cause a lowering of the level of ground waters. Thanks to the same cause, the same ravines carry off from the steppe a quantity of fertile earth, springs become obstructed and rivers and lakes choked with sand and mud. In consequence of what has been said, it is possible to a certain extent to agree even with the statement of some investigators that «were it not for the ravines and river valleys in steppes, there would even now be enough atmospheric precipitation to convert the whole chernoziom region into a swampy country suffering from an excess of moisture». This view, of course somewhat toned down, may in any case be defended in reference to the forest steppes, especially taking into consideration those characteristic saucer-shaped depressions which once in abundance covered certain parts of the Russian southern plains.

Describing in 1885 the virgin feather grass steppes, here and there preserved in the southern part of the government of Tambov, one investigator remarks as follows: «The surface of the steppes is always horizontal, and sprinkled with a number of shallow, rounded hollows or depressions, of various size and contents, delimited from each other by small, hardly perceptible elevations. All the water derived from rain and snow collects in these depressions, fills them up and transforms them into innumerable bogs and pools. The majority of the latter exists but a short while. The snow melts, the earth cracks, and they vanish. A few hold on a little longer, to the end of April or the beginning of May». Still fewer are those where the water remains to the middle and end of summer. «In accordance therewith the vegetation clothing the hollows also changes. Those rapidly drying up are always covered with herbage; those that remain somewhat longer under water grow over with willow bushes, and those which never dry up, or if so, not for long, are sometimes surrounded with trees chiefly aspen».

Similar hollows have been seen by the author also on the even elevated spots clothed with ancient forest, «with but this difference that in such localities hollows filled with water which does not dry up during the whole summer, and accordingly form lakes and swamps are incomparably more frequent». Exactly such closed cauldron-shaped depressions have been observed also in other localities. Finally during the recent exploration of the soil and geology of the government of Poltava plate-shaped depressions were observed in the districts of Poltava, Gadiach, Romny, Mirgorod, Lubny, Khorol, Zolotonosha, Kremenchug, Konstantinograd, Priluki and Pereyaslavl, in the last two cases not seldom filled with water even during a droughty summer.

It was the Poltava Expedition which proved that these cup-shaped depressions are far from occurring in all the steppes or universally. Even in the given region they are scattered very unevenly. In some places they are not to be seen at all, while

* Dokuchaev, Modes of formation of River Valleys, 1878; Inostrantsev, Geology, Vol. I, 1884 and 1889; Kostychev, Soils of the Chernoziom District of Russia, 1886; Mushketov, Physical geology, 1888.

next door they are in plenty. On the whole they are more frequently to be met with and more deeply and sharply delineated in virgin or but little ploughed steppes than on old arable land. Some of them are perfectly isolated and have no, visible at any rate, direct connection with the neighbouring ravines. Others on the contrary are evidently adapted to very gently sloping broad crests of different kinds of valleys and ravines.

To form a more definite idea of these curious hollows, attention may here be directed in somewhat greater detail to those of them which were observed in the Poltava government, just at the watershed of the Vorskla and the Psiol, between the Diachkov and Baliasnoe farms. In some places they sprinkled the steppe here, as a rule, quite evenly, like a human face with small pox, and yet they are scattered more or less in distinct groups. The distances between the cups of a given group were equal to 30 sagenes, 27 sagenes 1 arshine, 22 sagenes, 20 sagenes, 13 sagenes 2 arshines, 1 and 2 sagenes.

Their dimensions and depths differed equally little. In the group just mentioned, one of the hollows (say A) had a long diameter of 22 sagenes 2 arshines, a short diameter of 20½ sagenes; another (B), 17 sagenes 2 arshines and 16 sagenes, a third, both diameters about 10 sagenes, a fourth 5½ sagenes, and so on. Thus the prevailing form of steppe hollows is evidently elliptical or even quite round. In the Konstantinograd district occur depressions with a diameter of as much as 75 sagenes. Not seldom funnels of similar dimensions were observed by the author in the district of Pereyaslavl, some of them being even in the summer of 1890 filled with water.

The levelling carried out at the request of the author showed that the depth of the cup A, in reference to the level of the steppe prevailing in that region, was 1 arshine and 15 vershoks, that of B, 1 arshine 13 vershoks, that of the pass C, one to two arshines broad; between them, 9 vershoks. In other words, this pass is also somewhat lower than the neighbouring steppe. Approximately the same depth, from 1 to 2 arshines, was observed commonly in the other cups also, scattered over the steppe under consideration.

With the object of becoming more nearly aequainted with the structure of such hollows three pits were made at the request of the author of a depth of six to seven arshines: one D in the even steppe near the very edge of the hollow A, a second E in the bottom of A, and third F in the pass C between A and B. From each pit was taken a solid cylinder, now in the possession of the author whose nearer examination showed the following: The steppe chernoziom D contains humus 6·44 per cent, loss on ignition, 13·12 per cent; the soil from the bottom E, 5·49 per cent and 10·2 per cent respectively; the chernoziom from the pass F humus, 5·66 per cent, loss 11·66 per cent. The thickness of the chernozioms in the different cylinders varied thus: D 5′ 11″; E 5′ 2″ and F 4′ 7″.

Gentle bubbling with hydric chloride began in cylinder D from a depth of 1′ 8″, in cylinder F, 1′ 16″. Moreover, the lower the samples were taken, the more boisterously they effervesced. As for the cylinder E, taken from the bottom of the hollow, not only the soil and transition layers but also the subsoil did not show the slightest effervescence with acids.

Far from identical also proved to be the colouring and particularly the structure of the samples examined. The chernoziom, here is meant the highest layer of the soil, from the steppe D is of an average grain and dark gray hue; the soil from the pass F is coarser and somewhat lighter, while the sample taken from the bottom E

turned out to be much more fine-grained. The so-called transition layers in the two first samples have the ordinary character, that from the bottom of the hollow presents an exceedingly fine-grained, close mass, so dense that it is with difficulty softened with water. Its colour is gray, hardly distinguishable from that of the powder of the walnut layer of typical forest lands.

In both the steppe and the pass between the hollows there occurs an ordinary lösz subsoil effervescing boisterously with acids. The same soil in the bottom of the cup is absolutely devoid of carbonates and very compressed, so that it seems to be a heavy clay. In it is seen a quantity of particles of humus. A characteristic fact is that all the layers of chernoziom, taken from the bottom of the hollow, pass into each other much more gradually than in normal chernoziom. According to some data the soil covering the depressions in the Tambov district always cedes in fertility to the more elevated parts of the steppe, and the more considerable the depression the less fertile the soil, the thinner the layer of chernoziom, or even the latter quite vanishes.

As regards the proportion of carbonates in all the above mentioned soil cylinders (D, E, F), the following results were obtained by analysis. It appears that in the cylinder from the bottom of the hollow E, $CaCO_3$, at a depth of half a foot is contained to the extent of 0·18, 2½ feet 0·09, 5½ feet 0·104 per cent; the cylinder from the pass F at the same depths: 0·305, 7·502, 11·952; in the cylinder from the steppe D: 0·045, 8·970, 10·970 per cent.

As might be expected, the flora of such cup-shaped hollows proves everywhere different from that of the surrounding steppes and bears in the Poltava government a more aquatic character. Thus, in the hollows of the Konstantinograd district, clad in general with a typical steppe flora, are observed traces of meadow vegetation, which is peculiarly marked in the districts of Poltava and Pereyaslavl (trifolium pratense, montanum, lychnis viscaria, lychnis floscuculi, silene nutans, et cetera).

In the districts of Khorol and Kremenchug the funnels have a purely marsh and wash flora, nasturtium amphibium particularly abounding. But it is not everywhere so. In the government of Astrakhan where in the plain or steppe of Ergeni grow almost exclusively festuca and koeleria, in the hollows are collected the forms of the chernoziom steppe.

As noticed above, a still more important part is played by the hollows under consideration in the existence of the ground and other waters of each locality. During snowy and stormy winters immense heaps of snow are piled up upon the hollows surrounded with trees or only with shrubs. In spring, when the snow begins to melt, the water for a long time does not appear from under the drifts, because being sucked into the snow it is kept there by capillarity. The consequence of this is that a considerable part of the steppe becomes completely free of snow and cracks before the water, filling the hollows, comes over their banks. In such a case, not one particle of the snow arrested by the trees or shrubs in winter can leave the steppe. Seeking a passage to the ravines, the water at every step meets with new hollows. Filling them up, it loses both time and force, and before reaching the nearest ravine it is swallowed up by the soil now already thawed.

The consequences are very important. In early spring, when the snow is only just going, upon the virgin steppe no large torrents are to be seen, while upon the old plough land they are tearing and foaming in every direction, and washing away the

earth. Precisely in this way an immense quantity of fertile chernoziom soil is carried off from the ploughed field and so the ravines are formed. On the other hand the virgin steppe will use up nearly the whole of the atmospheric moisture; the level of its ground waters stands higher, the springs are more numerous and better provided, and as a consequence vegetation here, even in exclusively dry years when everything all around is parched up by the sun, is far better off. According to the observations of the same author, the beneficient action of the steppe hollows is particularly great and prominent if their walls are clod with trees or shrubs, which is of course quite intelligible, for the snow is still more arrested and still more water soaks into the ground.

From all that has been said it is perfectly obvious what an immense importance is possessed by various kinds of artificial ponds, especially on elevated situations, whence the water directly feeds the subsoil levels with moisture. As has been observed before, such an importance is far from attaching to those ponds which are situated in deep ravines and river valleys. Their waters are absorbed by the lower layers of the soil, and so completely lost, vanish so to say as far as the given spot is concerned.

But the picture rapidly and essentially changes as soon as virgin steppe or virgin forest come under the plough. Partly thanks to agricultural implements, but mainly to the destructive activity of rain and snow, the depressions gradually fall in, the crests between them become lowered and so the surface at first becomes more level. In connection with this the contents of the hollows diminishes to such a degree that it becomes insufficient to contain the former quantity of water. The excess of the latter, following the furrows, which easily form everywhere during severe frosts and heats, pours over into the neighbouring hollows, fills them to overflowing, and so on, until it reaches the slope of some ravine. The first beginning of a ditch is ready, in time it inevitably becomes transformed into a small ravine which annually widening and deepening will finally swallow up the hollows. The locality becomes rich in ravines, the snows collect no more on the steppe but in them, the level of the ground waters falls, and all this leads to the ordinary and already known consequences.

CHAPTER III.

The steppe soil; chernoziom, forest lands, saltmarshes, et cetera.

IT may now be considered to be clearly established that all soils, clothing the earth's surface with a more or less thin film of half a foot to six feet in thickness, must be divided into normal, lying on the spot where they were formed and appearing as far as possible with their primitive properties; and abnormal, which are either excessively washed or even moved bodily to other situations. It is completely demonstrated that the first of these, the normal soils, are the result of the very complex interaction of the following soil-formers: ground, climate, vegetable and animal organisms, the age of the country and of the contour of the locality *. In places where these variables are the same, the soils are identical; where they are different, the results of their activity cannot be the same, although this is of course not always the case. As is known, variable factors may supply or complete each other; the product may not change, if only the increase or diminution of one or another factor take a strictly defined course according to an ascertained scale.

Keeping all this in view and attending only to the most important representatives of normal soils, it is to be seen that in the Russian steppes the following types enjoy a particularly wide distribution, chernoziom (clay, clayey, sandy and marly), forest lands (in the ante-steppe, of several types) saltmarshes (several types) and sands. The composition, physical properties and geology of the bodies in question and consequently also their agricultural value, are essentially different, a proof of which is afforded by the tables, given at the end of this Chapter, of the chemical composition of chernoziom and forest lands. Here let it be observed that these tables are far from including the extreme types of soils, like saltmarshes and sands, but average types, most closely allied, standing side by side in the soil system, in a word, chernoziom and forest lands.

* Dokuchaev, «Russian Chernoziom». 1883.

As it is especially in the government of Poltava that the powerful influence upon the character of soils of the contour of a locality, its vegetation and the age of the country comes out with peculiar relief and precision, before all must attention be directed to this side of the question.

It is known that in the centre of Little Russia three principal types of contour prevail: a. level watershed plateaux; b. gently sloping inclines towards rivers and brooks; and finally, c. riverside lowlands. Corresponding thereto here also occur three predominating soils: more or less clayey chernozioms of the plateaux, valley sandy chernozioms and sands, in general flooded lands, of the river alluvial valleys. And this is the more intelligible that to all the said forms of contour in the government of Poltava, as said above, are confined to a certain extent also different ancient so-called mother rocks, possessing essentially a composition and physical character absolutely analogous to the soils superimposed to them.

But while the sands and in general the flooded soils, as also the vegetation covering them, are distinguished by a remarkable uniformity throughout the government of Poltava and those bordering on it, the chernoziom soils on the whole exhibit very essential differences in different regions. From the fully 500 determinations of the organic matter in the Poltava soils now in the possession of the writer it appears, among other things, that the richest chernozioms containing most humus, are exclusively peculiar to the districts of Konstantinograd, Zienkov, Poltava et cetera, in which predominate elevations of 70 to 90 sagenes. Chernoziom soils less rich in organic substances are met with in the low-lying Dnieper districts of Kobeliaki, Kremenchug, Zolotonosha and Pereyaslavl, with prevailing altitudes of from 40 to 60 sagenes; finally the districts with a mean elevation are clothed with chernoziom soils of average qualities. It is characteristic that such a statement is apparently equally adapted to clayey and sandy chernozioms, to the soils of the plateaux and of the valley slopes. If it be added that the age also of the eastern half of the government in question is greater than in the Dnieper western part, the close genetic connection will be evident between the character of the chernoziom, the height, relief and age of the different zones of the territory under consideration.

Not less instructive is the fact established by the writer as early as 1883 that the chernoziom of the Pavlovsk and Balashov districts, in other words, of the central part of the chernoziom zone, in the proportion of clay, humus, et cetera (see table), is commonly much richer than similar soils of south-western chernoziom Russia, namely in the Poltava government. In Little Russia clay chernozioms are a great rarity.

In still more salient relief in the government of Poltava are those regular relations everywhere existing between the character of soils and the vegetation clothing them or yet more so that once clothed them. The fact is that if deciduous forest establishes itself upon a given clayey, marly or clay rock in the widest sense of the terms, as for example upon lösz, boulder clayey or clay soil, et cetera, provided such forest vegetation remain here a sufficiently long time, it acts upon the given mother rock, changes it in such a manner that there results a very peculiar soil, as characteristic and constant for forest, as typical chernoziom is for steppe herbaceous vegetation. If such forest lands be compared with the chernozioms of a given region, there will prove to be no essential constant and definite difference between them either in their chemical and mineral com-

position or in their physico-mechanical properties. The best proof of this are the analytical data given below for the average representatives of chernoziom and forest lands. From these figures, amongst other things, it appears that there exist forest lands richer in nutritive substances and more fine-grained than the chernoziom soils, and vice versa. Hitherto in chemical respects there has been established only a constant difference in the character of humus and proportion of carbonates in the transitional (B) levels. There is however no doubt but that in time it will be possible to establish also more general differences. Still less distinguishable are the forest and chernoziom soils as regards their foundations or subsoils, which is intelligible as both one and the other not seldom lie literally two steps from each other upon one and the same typical lösz (Poltava government) or boulder clay (Pavlovsk district, Voronezh government).

On the other hand, it may be said that every peasant will at the first glance distinguish forest and chernoziom soils by the structure peculiar to them as easily as the mineralogist distinguishes by their form polymorphous minerals, for example, diamond and graphite, possessing as is known absolutely identical composition. In either case the structure of the bodies is essentially different. It is enough to glance even once at sections of forest land and chernoziom lying side by side upon one and the same foundation of lösz, in absolutely similar conditions of contour, for the whole justice of what has been said to be at once evident. Particularly great and sharp is the difference in the so-called transitional (B) soil level, which begins at a depth of from half a foot to a foot, ordinarily untouched by the plough, and consists wholly in the case of forest lands of grey irregularly formed nuts, perforated by and sometimes wrapped in a peculiar ashen gray extremely fine podzol-like substance. Nothing of the kind is observed in steppe chernoziom. If both these soils come under the plough, the colour of forest lands is always twice or thrice as light as that of the neighbouring chernoziom soils.

Besides this, in the subsoils of typical forest lands, so-called krotovinas, or the burrows of the Siberian and European marmots and similar steppe rodents, have never been observed, neither on their surface, steppe harrows or kurgans, which ordinarily surround ancient forest regions. Thanks to this method, founded on the character of the soil permitting the solution of the question not only of the existence but of the area of former forests, it has been possible for the author to prove that in an earlier, undoubtedly prehistoric time, forest occupied an immense area in the district of Poltava, upon the purely steppe right bank of the Vorskla, from 40 to 43 versts in length and about 15 to 17 versts at its greatest width. In the north they were conterminous with the government of Kharkov, in the west and south with the chernoziom steppes, and in the east were in immediate contact with the steep hilly bank of the Vorskla and its washes, in places even to this day covered with forest. In a word, the steppe forests of the Vorskla occupied in long past time at least 60,000 to 70,000 dessiatines; while their remains near Dikanka and Machekha now scarcely cover an area of 12,000 to 14,000 dessiatines.

Similar investigations show that forest lands occupied, for example in the Poltava district, about 34 per cent of the total area, present forests only 7 per cent; in Romny, 28, now 9; in Lubny 30, now only about 4 per cent. In the main, the same phenomenon is observed in the districts of Zienkov, Gadiach, Lokhvitsa, Mirgorod and others, as shown in the table of distribution of forests in the government of Poltava.

Table of the present and prehistoric forests of the government of Poltava.

Nos.	Districts.	Area of district in dessiatines [1].	I. Area of present forests [2].			II. Area of ancient forests [5].					I : II.
			Steppe forests [3].	Flooded forests.	Total [4].	Forest lands.	Transition forest-steppe soils.	Washes.	Sands.	Total.	
1	Konstantinograd . .	544,828	—	12,200	12,200 (2·2)	887 (0·16)	—	53,249	5,318	59,454 (10·9)	1 : 4·95
2	Romny	243,229	17,561 (7·02)	3,839	21,400 (8·8)	44,961 (18·05)	6,469	16,353	2,166	67,949 (27·9)	1 : 3·17
3	Zienkov	206,000	9,440 (4·06)	12,460	21,900 (10·6)	46,654 (22·04)	22,875	22,777	3,351	95,657 (46·4)	1 : 4·38
4	Gadiach.	200,000	2,633 (1·03)	15,167	17,800 (8·9)	3,123 (1·06)	3,286	32,604	3,032	42,045 (21·0)	1 : 2·36
5	Lokhvitsa	244,060	13,000 (5·03)	7,400	20,400 (8·3)	23,085 (9·04)	—	24,555	2,747	50,387 (20·8)	1 : 2·47
6	Priluki	287,222	5,080 (1·08)	15,320	20,400 (7·1)	14,605 (5·01)	7,620	31,496	16,002	69,723 (24·2)	1 : 3·40
7	Poltava	306,709	9,198 (3·00)	12,802	22,000 (7·1)	47,350 (15·04)	8,866	42,066	5,654	103,936 (33·9)	1 : 4·77
8	Mirgorod	253,563	6,753 (2·07)	7,747	14,500 (5·7)	11,303 (4·04)	—	18,224	17,145	35,369 (14·4)	1 : 2·53
9	Khorol	294,043	—	5,200	5,200 (1·9)	2,058 (0·69)	6,527	48,347	13,440	70,372 (23·9)	1 : 12·58 [6]
10	Pereyaslavl . . .	374,344	9,588 (2·06)	27,112	36,700 (9·8)	1,143 (0·30)	22,638	58,420	29,464	111,665 (29·8)	1 : 3·04
11	Piriatin.	296,123	1,079 (0·37)	7,321	8,400 (2·8)	—	—	34,099	—	34,099 (11·6)	1 : 4·15
12	Lubny	220,555	5,956 (2·07)	3,944	9,900 (4·1)	22,241 (10·01)	4,657	33,527	4,778	65,213 (29·5)	1 : 7·20
13	Kobeliaki	329,017	—	12,100	12,100 (3·7)	—	—	40,957	23,050	64,007 (20·0)	1 : 5·40
14	Zolotonosha	394,027	—	15,400	15,400 (3·8)	—	—	132,435	—	132,435 (33·6)	1 : 8·60
15	Kremenchug . . .	310,572	—	10,000	10,000 (3·2)	—	—	45,910	6,413	52,323 (16·9)	1 : 5·28

[1] From survey of government of Poltava.
[2] The areas were calculated by the Volkman method, by weighing.
[3] Special Map of European Russia, sheets 31, 32, 46 and 47 (1868 –1884).
[4] Professor Genko, «Statistics of the forests of European Russia» (1888).
[5] Soil map of the Poltava district, compiled by Prof. Dokuchaev and his pupils (1893).
[6] This large figure is explained by the immense development of washes within the given district.

It is highly instructive that there is no trace not only of typical, with walnut layer, but even of transitional forest steppe soils in the districts of Kremenchug, Kobeliaki and Zolotonosha, notwithstanding that they are in immediate contact with the washes of the Dnieper, wooded from the earliest times. But on the other hand these districts are the lowest, the prevailing elevations being from 40 to 60 sagenes, and Kremenchug and Kobeliaki are furthermore very rich in salines. There are no forest lands in the low and highly salt-marshy Piriatin district, and in the greater part of that of Khorol possessing the same character, while in Lubny they are exclusively confined to the high-lying, splendidly drained corner between the Udai and the Sula. In general it may be affirmed that in the government of Poltava forest lands do not descend lower than approximately 65 sagenes above sea level. Such an altitude was for the ancient forests a fatal limit beyond which they did not dare to go, although side by side, but upon washes and flooded lands or sands adjacent to such; and perhaps upon light sandy soils impenetrable forests flourished splendidly. Thus, between the given soils on the one hand, and altitude and age of locality on the other, there also exists a constant relation; in other words, the distribution of these soils also is subject to strict laws. This is the distribution in the Poltava government of the predominating soil types of chernoziom and forest lands.

The geography of the saltmarshes is subject to essentially different conditions and causes. Contrary to expectations and the data of literature, it was established by the Poltava Soil and Geology Expedition that saltmarshes, and in general, saline soils occupy extensive areas in the Poltava government, especially in the districts of Kobeliaki, Kremenchug, the south-western half of Khorol, Pereyaslavl, and the neighbouring portions of Priluki, Piriatin and Lubny, in a word, in that wide Dnieper zone of the Poltava steppes, not less than 40 to 50 versts across, exclusive of washes, which descends approximately below 65 sagenes above sea level. Here various kinds of salines, alternating with absolutely fresh soil and small half-salt swamps, in some parts occupy whole volosts and extend at times tens of versts in length. On the contrary, with elevation of the locality, especially in the districts conterminous with the Kharkov government, the area occupied by saltmarshes and the typical character of the latter fall off. The same rule, the same strict dependence of the distribution of saltmarshes upon the contour and absolute altitude of the locality on the whole is observed in every district. As particularly striking examples may be quoted those of Priluki, Piriatin and Khorol districts.

According to their situation, the saltmarshes of the Poltava government may be thrown into three principal groups: a. the widest dissemination and most typical character are enjoyed by those of them which lie upon gentle slopes, second terraces, running down to the Vorskla, Psiol, Khorol, Sula, et cetera. Next follow: b. the saline plateaux, met with sporadically, in the form of separate islets, spread on the bottom of various kinds of hollows and depressions among the hilly chernoziom. Still more rarely have been observed the less typical: c. saline patches scattered sometimes over the comparatively elevated parts of the river washes.

As appears from various investigations, in its most common form, the Poltava saltmarsh has the following structure. Upon its surface lies a white, very sandy, discontinuous crust, usually not exceeding some tenths of an inch in thickness, and perceptibly effervescing on the addition of hydric chloride. Lower down lies an extremely sticky, in

wet weather and almost stony in dry, mass not seldom falling into two layers, an upper columnar, more palely stained with humus, and a lower, often perfectly black layer disintegrating into sharp-angled pieces. The ordinary subsoil is a fine-grained marl containing up to 17 per cent of carbonate of lime undoubtedly of recent origin, very tenacious in a moist condition, and hardening after drying almost to a mass of stone. Its thickness is about 5 feet. Still lower lies in the vast majority of cases, at any rate in the second terraces and washes, white quarts sand not seldom more or less calcareous. Ground waters, sometimes highly mineral in saltmarshes, lie almost always in the said sand, commonly at a depth of about a sagene, often less, which is evidently caused, at any rate in some places, by the existence in the deep sandy subsoil of a fairly dense streak cemented together with brown oxide of iron.

In the saltmarshes of the Poltava government has been established the undoubted presence of the chlorides and sulphates of the alkalies, carbonates being particularly abundant.

To finish with the soils, it is enough to add that in the Poltava government as everywhere upon the steep slopes of the right elevated banks of the rivers Vorskla, Sula, Psiol et cetera, and partly at their foot and on the steppe plateau along the banks, stretch more or less narrow strips of abnormal soils, quickly interrupted, of excessively irregular form, with a quantity of spurs and branches running into the wash land and at times into the steppe. Here sometimes on but a dessiatine of surface may be met chernoziom plateaux usually subjected to washing, and chernoziom sandy soil, saltmarsh and river sand, and outcrops of lösz, boulder clay, freshwater marl, varicoloured clays and white quartz sands, but most often of all the most heterogeneous, in composition and physical characters, mixtures, in the shape of rain alluvium, of all the above mentioned formations. Add to this, endless variations in contour, illumination, water supply, springs here commonly occurring, and so on, and an idea may be formed of the infinite, so to say, variety of natural conditions peculiar to the hilly slopes of Russian rivers. Finally, as regards river washes, these are occupied by the most heterogeneous drift soils composed of river and ravine alluvium, alternating with pure marsh formations and sands. The latter, in the majority of cases, the remains of white tertiary sands, not unfrequently pass into the second terrace, and here elaborated by the wind, form in some places dunes. It is instructive that in many spots along the banks of the Dnieper, Vorskla, Psiol et cetera, it may be seen that these now absolutely naked sands, mobile as quicksilver, were once covered with a continuous vegetation, in some places herbaceous, in others forest. Thus in the very neighbourhood of Kremenchug, at Great Sarochintsy, the birthplace of N. V. Gogol, on the Psiol, at N. Senzhary on the Vorskla, and elsewhere, under the yellowish-white shifting sands a perfectly normal soil has been preserved, a dark gray, fairly compact chernoziom sandy soil, at Kremenchug even in the form of two beds separated by the same dune sands.

Chemical composition of chernoziom and forest lands.

Localities.	Hygroscopic water, H_2O, evaporating at 100°.	Organic matter.	Nitrogen.	Separate constituents.					Hot 10 per cent, HCl.					Hot concentrated H_2SO_4.		Quartz sand.	Clay, estimated by coefficient.
				Total loss on ignition.	Potassic oxide, K_2O.	Calcic oxide, CaO.	Phosphoric anhydride, P_2O_5.	Silica, SiO_2.	Potassic oxide, K_2O.	Calcic oxide, CaO.	Silica, SiO_2.	Total soluble matter.	Insoluble remainder.	Alumina, Al_2O_3.	Silica β, SiO_2.		
1. CHERNOZIOM PLATEAU.																	
Bogodukhovka, Zolotonosha district, Poltava gov.. . .	2·713%	4·832	0·203	6·835	1·440	1·208	0·132	74,972	0·235	1·005	3,913	11·99	81·175	4·632	5·492	22·352	18·528
Diachkovo, Poltava district	4·02	7·78	—	15·15	1·82	2·14	0·13	65,91	—	1·18	17·189	28·299	56·55	7·88	27·717	29·43	81·52
Pady, Gusev farm, Balashov district, Saratov gov. . .	6·27	11·178	0·548	20·89	2·454	1·560	0·279	54,29	0·462	1·515	15·17	—	45·675	9·97	21·25	20·39	89·88
II. FOREST LANDS.																	
Machekha, Poltava district	1·864%	3·543	0·387	7·913	1·757	0·956	0·0906 (10% HCl)	73,478	0·956	0·677	6·011	14·932	77·155	6·48	—	20·01	25·92
Between Kolaidintsy and Klepachi, Lubny district.	1·346	—	0·179	5·636	0·358	1·434	0·0665	81,124	0·158	0·167	4·551	7·787	86·577	3·683	9·062	35·877	14·052
Shipov-forest, Pavlovsk district, Voronezh gov. . . .	4·98	—	0·412	19·04	0·927	1·52	0·328	57,58	0·253	1·15	13·92	—	52·10	8·70	17·32	—	34·80
III. VALLEY CHERNOZIOM.																	
Vishniki, Khorol district, Poltava gov.	2·280	4·960	0·284	8·734	1·348	1·275	0·081	75·633	0·342	0·467	4·664	9·652	81·614	4·243	8·565	48·456	16·972

Mechanical composition and physical properties of chernoziom and forest lands.

Localities.	Specific gravity.	Weight of litre in grams.	Resistance to crushing, in grams.	Mechanical analysis. Roots, water and organic matter.	Mechanical analysis. Sand. ½ to ¼ mm.	Mechanical analysis. Fine sand and dust. ¼—0·01	Mechanical analysis. Mud. 0·01	Relation to water. Capillarity. 10 minutes. (Millimetres.)	Capillarity. 20 minutes. (Millimetres.)	Capillarity. 30 minutes. (Millimetres.)	Capillarity. 6 hours. (Millimetres.)	Capillarity. 18 hours. (Millimetres.)	Capillarity. Time of rising to 30 centim. (Hr. min.)	Evaporation in percentage of air-dry soil. Third day.	Evaporation. Fifth day.	Evaporation. Tenth day.	Evaporation. Fifteenth day.	Capacity for moisture at 20° C. in per cent of air-dry soil.	Hygroscopicity of soil in per cent, dried at 100° C.	Time of penetration of water through layer of soil 18 centim. thick. (Hr. min.)	Relation to heat. Heating of soil to 80° C.	Relation to heat. Cooling of heated soil to 21° C.
I. CHERNOZIOM PLATEAU.																						
Diachkov, Poltava district.	2,572	1,190	4,950	12·8	0·14	56·33	30·73	39	52	63	193	272	16 40	32·6	39·7	40·4	—	40·81	8·8	3 10	36	120
II. FOREST LANDS.																						
Machekha, Poltava district.	2,592	1,410	7,500	7·4	0·18	64·89	27·53	33	41	48	143	200	28 —	36·6	42·4	—	—	42·96	6·1	22 10	30	120
Between Kalaidintsy and Klepachi, Lubny district	2,587	1,230	1,850	5·1	0·11	77·27	17·52	63	85	102	—	—	6 20	42·3	47·4	—	—	47·61	3·1	12 5	28	110
III. VALLEY CHERNOZIOM.																						
Vishniaki, Khorol district.	2,620	1,360	800	7·8	6·38	61·65	24·13	50	69	83	261	—	8 25	34·3	40·0	40·1	40·1	40·44	5·4	7 —	30	120

CHAPTER IV.

Vegetation of the Steppes.

AS might be expected, the wild flora of the government of Poltava is distributed in accordance with the absolute altitudes and age of the locality, and the character of the contour and soils. This government must be divided from the point of view of the flora into two halves, the western or low-lying, and the eastern or elevated. In the latter the vegetable formations are clearly defined; in the Dnieper region they are mixed. Besides this, the regions of the richest flora and the habitat of the rarest forms coincide with the highest parts of the government. Centres for such forms are the Konstantinograd district in which occur many plants confined to the said district; the northern part of the Poltava district, that of Zienkov and partly the Kobeliaki district. Further west rare forms occur only sporadically and are still confined to the highest points of the districts of Mirgorod, Romny and Lubny.

Here will be noted the chief features of the most important vegetable formations of the territory under consideration.

STEPPES OR PRAIRIES.

Unfortunately but poor fragments now remain of the typical steppe flora which once clothed uninterruptedly the chernoziom steppes of the Poltava government. The flora of the chernoziom prairie is here already passing into history. In the most classical spots of its development the highly characteristic steppe forms, stipa pennata, stipa capillata, campanula Sibirica, falcaria Rivini, gypsophila paniculata, and very many other plants, have become rarer than even in the settled parts of the government of Nizhni-Novgorod. Unploughed kurgans, here and there the steep slopes of gulleys and of river valleys in the Dnieper districts, and a few poor dessiatines of virgin steppe accidentally escaped and annually awaiting their destruction, this is all that remains of the rich and characteristic flora which once attracted to itself hordes of nomads. The only corner where virgin steppes are still (1888–89) partially preserved, is situated in the most eastern section of the Konstantinograd district upon the lands of Messrs. Strukov and Bezak. Here even to-day, in the midst of an immense, dry, perfectly treeless steppe, stipa pennata grows as high as a man's waist. Here also to-day caragana frutescens, amygdalus nana and prunus chamaecerasus form although low-growing yet thick, often impenetrable bushes, maintaining a stubborn fight with

cattle and man. Here, even now, spermophilus musicus swarms, otis tarda breeds in large numbers and bobac arcticus ends its days reaching to the prehistoric age. Add two or three shepherd huts appearing on the horizon, and scattered steppe barrows or kurgans perched on the higher mounds and this is all that the eye can rest on in the virgin steppe. Rivers, lakes, habitations, hills, even gullies, are not to be seen for tens of versts away, not seldom to the very horizon.

It is characteristic of such undisturbed steppes that even in extraordinarily dry years, when land at rest and artificial meadows are not mown at all, the yield of hay is never less than eighty pouds per dessiatine.

A yet mightier herbaceous vegetation clothes the virgin steppes of the Baraba and Altai. Middendorf describes the northern and eastern borders of the Baraba in the following words: «Here the traveller is drowned in a sea of vegetation... Sedums, two and a half feet high, the rose here constantly to be met with and attaining three and a half feet, and a mass of other plants, in some places, are so interlaced together with lathyrus, that after making a hundred paces with difficulty one is obliged to abandon any further attempt to pass through the thick, green tangle. Over this flowery carpet project the red heads of uniformly scattered sanguisorba, the red and yellow heads of of a mass of tall syngenesiae, the nettle whose efflorescence rises higher than a man's hands joined above his head, and plants of heracleum, eight and a half feet in height».

Between Barnaoul and Biisk in some places the vegetation covers the soil so thickly that the turf was as difficult to cut as felt.

There is no doubt but that an equally dense carpet of plants once covered the whole government of Poltava. With the approach of autumn this sea of vegetation gradually fades, and the plants composing it bow down and become entangled. In winter the snow finally crushes them to the ground, but few of the strongest stalks still remain standing. The next year a new generation grows up, to be subjected to the same fate, and so on. As a result, after the passage of several years, the unmown expanse assumes the following appearance. The whole surface of the soil is covered with dead stalks in various stages of decomposition. The lower, oldest, and almost rotten layer, lies close pressed to the soil, or more accurately, mould left by the completely putrefied weeds. The layer of stems of recent origin not yet torn from the roots covers up the older layers protecting them from being blown away by the wind. The complete immobility of the whole dead covering is still further secured by the fresh vegetation everywhere piercing through it in summer.

This characteristic description throwing so much light on the formation of the Russian chernoziom, due to a resident investigator of the Tambov steppes, is completely confirmed by the writer's own later observations made in the steppes of the Konstantinograd district of which the following are two examples.

Half-way between the villages of Dar-Nadezhda and Nagornoe, in the midst of the most typical steppe surroundings, upon a splendid chernoziom, are preserved a few small, extraordinarily thick, shrubby thickets composed of locust tree, meadow sweet, dwarf almond, steppe cherry and cytisus. Under cover of these bushes grew clematis integrifolia, aconitum anthora, paeonia tenuifolia, statice gmelini and latifolia, stipa capillata, phlomis pungens, falcaria Rivini, lithospermum arvense, scabiosa ucranica, vinca herbacea, berteroa incana, agrimonia pilosa, and others. Under these thickets, then the favourite haunt of adders, was formed a compact vegetable felt from

one to one and a half inches in thickness, cut with great difficulty by a sharp spade, and in no essential respect differing from the similar vegetable covering to be found in virgin forests *. Immediately beneath was the chernoziom, uncommonly fine-grained, indeed of a sand-like structure, with a mass of the most varied, minute animal organisms and thousands of roots.

A not less typical virgin feather-grass steppe, also with small islets of cherry and thorn, may be observed on Strukov's estate between the brooks Vshivaya and Senzharovka. But as these steppes have been more than once burnt up, otherwise they were not leased to cattle owners for pasture, instead of felt upon their surface lay a sort of brown mass so thick that the foot trod on the steppe as on a fine Persian carpet. Below it also was found a remarkably mealy chernoziom.

What must have the steppes been like when they were not mown, when they were not at the mercy of incendiaries and not trodden down by cattle?

The fact mentioned of the covering of virgin steppes with essentially the same vegetable felt, as is observed also in virgin forests, not only alters the statement of the question as to the process of accumulation of humus in the chernoziom, but throws a certain light upon the long passed water economy of the steppe regions of Russia. It appears in the first place that in the autumn the earth on the unmown steppe freezes probably to a less depth and in spring thaws much later than on the mown or otherwise bared steppe. In the second place, in consequence of the existence of the crumbling vegetable felt and of the mass of vegetation in summer, a much larger quantity of rain and spring moisture is arrested upon the virgin steppes, which is especially aided by the peculiar contour of the virgin steppe. In the third place, from the experiments carried out in the field, in the steppe, and not in the study, it is clear that different kinds of soils absorb the more rain and spring moisture, evaporate less of it, give up the more of it to their soils, the nearer the structure of these lands approaches the granulated structure of virgin steppe chernoziom soils. This explains a whole series of extremely important facts, among which it is not superfluous here to mention two.

Both in early spring and after heavy rains, large torrents of water upon virgin steppe are not to be seen, while upon long since ploughed lands they run clamouring and foaming in every direction. In the region of the feather-grass, never-ploughed steppes, various kinds of excavations by the action of water are developed very slowly and usually with interruptions. In a word, the virgin steppe vegetation must have influenced the water economy of the steppe as favourably as the forest. And once this is so, there is no ground for having recourse to a change of climate in the steppe region in order to explain: a. the impoverishment of the latter in ground waters; b. the frequently recurring failure of crops from drought, inasmuch as the mere alteration of the properties of the former steppes, due to their ploughing up and their condensation from the pasturing of flocks of sheep and herds of cattle, might fundamentally alter the relation of the soils to moisture. It must be supposed that the former steppe with its gigantic flora must have had no less importance for the steppe region than that which is recognized as belonging to the forest.

* Docuchaev, «Methods of investigating the question: Were there forests in steppe Russia?» 1889.

STEPPE AND VALLEY FORESTS.

In the Poltava government, forests constitute an equally essential and probably equally ancient vegetable formation with the feather-grass steppes. But before proceeding to the restoration of the forest area, it is necessary to say a few words on the present position of the forest question in general, the more so as it is far from being quite exact and scientific.

When it is a question of the quantity of forest in any government or district, when the frightful destruction of timber, for example, is under discussion, then of course, use may be made of the ordinary statistical data on forests. But on the other hand, in comparing the woodiness of one place with another, and still in trying to elucidate the history of Russian forest steppes the said statistical data must unconditionally be distinguished into at least two types, namely, according as they refer to the forests of the river valleys and of the dry, unbroken steppes. In a similar manner, when deciding the question of the former existence of forests in the steppes of Russia, it is not permissible to refer, as to a positive proof, to the possibility of the artificial growth of forest in the steppes. At that time, probably even in the prehistoric period, no one could prepare the ground for forest, sow trees, weed them, et cetera.

This is clear; as will appear below, the forests of the river valleys exist in the midst of exceptional, although everywhere extremely uniform, conditions of an essentially different character than the surroundings of the neighbouring steppe, and in general, non-river localities. Therefore such forest sections properly can have no relation to the question of forest steppe. These are the proofs: It has been long established that forests along river valleys enter extremely easily the region of tundra. The fact has long been pointed out that, even in the midst of the Sahara, trees appear where there is water. It is further known that the rivers Dniester, Dnieper, Don, lower Volga and Ural, and the Salado in La Plata, the Nile and Quorra in Africa, among others, are clothed along their banks with growths of trees, even where for tens of versts around stretch steppes and even deserts. But without any doubt the best example in this case is the celebrated Hylaia of Herodotus, which caused many men of science to consider the southern steppes of Russia as having once been covered with unbroken forest down to the shores of the Black Sea and the Sea of Azov.

Thus it is evident that to explain the existence of forests in the river valleys is far from understanding their absence or presence on the neighbouring dry steppe. These are really two quite distinct phenomena and are perfectly capable of existing independent of each other; in any case, river forests can exist without steppe forests. The same is often repeated in the Poltava government.

As far as concerns the forest flora, both perennial and annual, of the river valleys, it is known that it everywhere bears a very motley character. It is the most heterogeneous mixture of local and imported forms, marsh, steppe and meadow flora, representatives of coniferous and deciduous trees, huge timber trees and paltry bushes, in the quaintest and most inconstant combinations. And this is easily explained. Here on the river, old and new, washes, almost all the most important physical conditions for the life of plants, as soil, moisture, light and change with unusual rapidity and within the most insignificant distances. But on the other hand, after studying these changes circumstantially

in any determined point of the given river-washed land, one may arrive at the conviction that essentially the same thing is repeated along the whole river valley, often over tens of degrees of latitude.

Thanks precisely to this last circumstance, and also to the abounding in water of riverine soils, in the main sands and marsh deposit lands, especially in spring time, valley forests exhibit very feeble dependence upon local, climatic conditions, and on the whole, are sharply distinguished from the forests of the neighbouring dry steppe. The same thing is established also for the Poltava government.

Alike on the basis of the considerations just referred to, and judging by the present distribution of forest vegetation along the river valleys, and especially in view of a whole series of historical data, it may be positively affirmed that in prehistoric times all the valleys of our steppes, at any rate the valleys whose origin is situated in the forest zone of Russia, were clothed with a mixed forest vegetation right up to the Black Sea and Sea of Azov. It is here enough to note the undoubted existence of the Herodotian Hylaia, mentioned above, at the very mouth of the Dnieper, and the forest once existing on the Isthmus of Perekop.

But these forests, be it repeated, may have no relation to the flora of the neighbouring steppes and wildernesses, which were perfectly free to remain such from the earliest ages.

To understand the character of the forest steppe proper, attention must be drawn to the steppe forests growing in the midst of dry waterless plains, it is necessary to study there the conditions of vegetable life and then to try to restore the ancient, as it were, natural distribution of these forests, a task which will be performed, in reference to the Poltava government.

A classical example of such plantations, still preserved, may be afforded by the Dikanka forests, about 2,000 dessiatines in area, situated in the Poltava district surrounded on three sides by most typical chernoziom steppe, and bordering on the fourth, on the right, elevated bank of the river Vorskla.

As is known, the orographical and geological conditions of this locality are typically steppe; here, there is the same remarkable plain, the same characteristic lösz as subsoil, the same depth of the wells. Only within one to three versts of the bank precipice of the Vorskla, the locality becomes very hilly, deep holes and gulleys appear, and on their slopes are to be seen, here and there, first of all reddish brown, boulderless clays and fresh water marls, then motley clays, and finally white quartz sands.

Here as everywhere the hilliness and the variety of the bed rocks increase, particularly on the bank slope of the Vorskla and at its foot, where there occurs moreover, a multitude of the most heterogeneous deposits of the so-called rain or ravine alluvium. On the same inclines of the ravines and gulleys, and most of all on the slope leading to the river Vorskla, appears a considerable number of springs, at one time feeble, scarcely perceptible, at another so considerable as to form at the foot of the bank precipice constant basins and even small oblong lakelets.

Such are the essentially oro-hydrographical and geological conditions customary for the Poltava government in which the Dikanka steppe forests are situated. Of such forests, however, there is not a trace in a thousand other cases absolutely identical to the eye.

The Dikanka forest must be divided according to the general character of its

forest vegetation into two halves: the more western, so-called Nikolaev forest, contiguous to the chernoziom steppes and situated upon a perfectly level space, and the eastern, more elevated Vorskla half, through which passes the line of the watershed between the Vorskla and the Psiol, or more exactly, its tributary the Goltva which is, as above observed, much more hilly. The prevailing trees in the Nikolaev forest are the oak, quercus pedunculata, and sessiliflora, maple (acer platanoides campestre), and to the outskirts, acer Tataricum, the elm (ulmus campestris, effusa and suberosa), the ash, salix caprea, tilia Europaea, and very rarely, populus tremula. The birch is here entirely absent, the wild apple and pear are to be found but seldom. Finally, as a great rarity, a specimen or so of hardbeam (carpinus betulus) may be met with.

All the above named species, with the exception of acer Tataricum, represent tall-growing trees with splendidly developed crowns, forming in summer a thick canopy of charming greenery in which from morning to night sing and chirp a multitude of birds. As late as 1888 it was possible to see here trunks of oak over twenty-four feet in circumference. Similar specimens of oak up to a sagene in diameter were observed here in the fifties, and very recently, much further south than Poltava, upon the celebrated island of Khortitsa, where was situated the s i e c h or camp of the Transcataract Cossacks, an oak trunk was found as much as three sagenes round. In the forests along the river Samara, falling into the Dnieper much further south than the Poltava government, there are still preserved pines six arshines, and oaks nine arshines in circumference. The forest here stretches along both banks of the river for about a hundred versts and consists of oak, pine, elm, maple, ash, linden, birch, and other trees. In the Samara forests, known already to Beauplan, were found the horns of the ure-ox.

Under the canopy of the shady trees of the Nikolaev forest, thanks to their lofty trunks, in places brushwood springs up quite impenetrable, exceeding a man's height, and while characteristic of deciduous forests in general, are here developed in great luxuriance. It is composed of the following species: corylus avellana, evonimus Europaeus and verrucosus, cornus sanguinea, more rarely, only in the outskirts, crataegus oxyacantha, prunus spinosa, rosa canina, and rhamnus cathartica. These shrubs do not properly enter into the forest growth, but only fringe it. The brushwood, together with the saplings, forms as it were a second arboreal story, commonly preserved after the timber has been cut down, and constituting a growth shading the soil, which even without them is protected from the sun's rays. They permit the development of a but very inconsiderable number of shade-growing forms, unable to bear the direct action of the sun's rays.

In the development of the last or herbaceous flora of the forest, three periods may be distinguished, corresponding to the months of April, May and June. Nearly all the spring forms here belong to the perennials, propagated not so much by seeds as by bulbs and runners, as a typical example of which dentaria bulbifera may be taken. Even such forms as propagate here by the seed, as for example, asarum Europaeum, viola mirabilis, bury their capsules in the soil, holding it unsafe to trust their seeds to tho faint, forest breeze. Ferns are wholly absent from the Nikolaev forest.

Passing to the bank zone of the Vorskla, in this part the most elevated of the Poltava district, considerable change in the character of the vegetation is at once noticeable. Hardbeam, almost unknown further west, here little by little becomes the chief component part of the forest, and in the north-eastern corner completely drives

out all other trees. Its gray, waving, straight stems attain a man's girth and more. At the same time, on these elevated shores of the Vorskla, the forest flora attains its greatest fulness. The dentaria, rare in the Nikolaev forest, here becomes a common plant, and to it is added the still rarer periwinkle (vinca minor). Here are the unique specimens in the whole district of bear-garlic (allium ursinum) and trifolium procumbens, whose floral centres are the Caucasus and the Altai. Lower down, on the sandy sections of the Vorskla slope, grow pulmonaria azurea and stachis Germanica, and on the sides of the gulleys, the ferns, pteris aquilina, cystopteris fragilis and polypodium. It is characteristic that the undergrowth and herbaceous flora are here scantier than in the more western part of the Dikanka woods.

The above described type of the broad-leaved steppe forests, and the character of the distribution in them of vegetable forms, is repeated with remarkable constancy in all the central parts of the government, namely, in the districts of Poltava, Kobeliaki, Mirgorod, Lokhvitsa, Khorol, and Lubny. Everywhere it becomes poorer in forms and less characteristic in the direction of the chernoziom sections; on the contrary, near the high bank of the limiting river it attains the greatest fulness of forms, being accompanied by species rare in the government, and not occurring in other parts than those near the Dnieper, but extraordinarily common on the boundary of the forest flora and the subalpine meadows in the Caucasus.

Bearing all this in mind, the thought involuntarily arises that in the eastern and north-eastern parts of the Poltava government which are highest and oldest, the forest vegetation only feels perfectly at home on the edges of the high banks of rivers and streams, where moisture is absorbed from the underlying strata. Here is the greatest number of forest forms; they are apparently the centres of the dissemination of the forest whence it moved into the depths of the watersheds, crumbling the soil with its roots and creating the so-called walnut layer of the soil.

As appears from the foregoing table, such purely steppe, always broad-leaved, forests at the present time occur exclusively in those districts of the government of Poltava whose elevation does not descend below approximately 65 sagenes. Thus, in the Poltava district their area is equal to 3 per cent, in that of Romny 7 per cent, and Lubny 2·7 per cent, of the total surface. Approximately the same figures are found in the districts of Zienkov, Gadiach, and others, while in the districts of Kobeliaki, Kremenchoug, Zolotonosha and the vast majority of the districts of Konstantinograd, Khorol, Lubny, Piriatin, Priluki and Pereyaslavl and in general in those steppes whose absolute elevation is below 65 sagenes, there is no trace of the contemporary steppe forests. And this is the more characteristic and instructive that side by side on the washes of the Dnieper, Vorskla, Sula, Psiol and other rivers, untouched forests have existed from time immemorial; in places are preserved even to-day, forming here and there on the cornice of the elevated steppe banks, peculiar forest walls, cut off as with a knife, and visible at a distance in the steppe. But as a rule immediately behind such a wall begin kurgans, burrows made by rodents, and typical chernoziom, the truest indications and companions of ancient steppes. If this wall anywhere ceases to be such, and sends out shoots and separate tongues of forest into the steppe, this is always on the sides of gulleys and brooks, and even so for very insignificant distances. It may be said that the sole, and in the highest degree instructive, exception is presented by a small patch of coniferous forest situated on the dune sands of the second steppe terrace of the Dnieper,

on the very boundary of the districts of Zolotonosha and Pereyaslavl. Probably, in long since vanished times, such exceptions existed also in other places, for example in the district of Pereyaslavl, near the boundary of Piriatin, but everywhere upon sands.

But still more instructive is the fact, already quoted above, that ancient forests, either in historic or prehistoric times, never existed in the Dnieper districts, such as Kobeliaki, Kremenchoug, Zolotonosha, Piriatin, almost all Khorol, the central and western third of Konstantinograd, the western half of Lubny and Priluki and the two southern thirds of Pereyaslavl; in other words, there never were forests in those steppes of the Poltava government which are lower than 65 sagenes above sea level, notwithstanding the immediate neighbourhood of some of the said districts to the washes of the Dnieper, and several other more or less considerable rivers, so to say, wooded from all time.

On the other hand, it is instructive that ancient forests, as appears upon the soil map of the Poltava government, even then formed not one continuous zone or extensive section, joining on, so to say, to the Kiev Polessie or forest region, or to that of Chernigov but were scattered as now in separate strips and islets along the elevated bank sides of the Vorskla, Sula, Psiol, Khorol, Udai, Lokhvitsa and other streams, where on the one hand, they immerged in the forests of the washes, and on the other, at one to ten versts, rarely more, from the river, exchanged for boundless chernoziom steppes. In their bank side parts these ancient forests also, like those of Dikanka of to-day, were scored by a mass of pits and old gullies, so that the locality assumed a very hilly appearance, splendidly drained, and relatively speaking of course, in some places rich in springs.

In proportion as the neighbouring rivers are left behind, more and more frequently appear small level areas; their extent gradually enlarges; and finally there sets in the most perfect steppe, except that chernoziom is replaced by forest lands. As a locus classicus for the study of the orographical and geological conditions of such ancient forest plantations, may be taken the immediate neighbourhood of Poltava, some five, ten and fifteen versts in every direction, where once stood untouched forests which have left unmistakable traces in the form of most typical wood soils easily observable now in any town ditch. In the site of these very ancient forests was fought the celebrated fight of Poltava, which decided the fate of Russia as a great and united whole. The grave of the Swedes is covered to a considerable extent with this same forest earth.

Thus, the insular character of the forests in the Little Russian fore-steppe, in other words, the peculiar character of the forest steppe itself, is a perfectly natural phenomenon, existing from all time, and not accidental or temporary, wherefore its causes may and must be rooted only in constantly acting physical peculiarities of the country and in its geological part, and not in the influence of the stepniak or dweller in the steppe, who is supposed to have burnt the forest, and still less in the recent cutting down of the timber.

This phenomenon, the insular character of the Little Russian fore-steppe, is as regular, as old, as the exceedingly instructive fact, that in the Poltava government, side by side with purely forest and not less typical feather grass-steppe flora, there not only finds shelter, but is widely spread, a wormwood-saltmarsh flora, strictly confined to those peculiar salines discussed above. And such neighbourhood is the more significant, its interest, scientific and practical, is the higher and more considerable, that not so long ago was established beyond doubt in the same forest steppe, near Kharkov, Voronezh,

Bobrov, and other places, the existence of moss swamps with a flora allied to that of the tundras.

The saltmarsh flora of the Poltava government is, unfortunately, far from having been studied with that care which it deserves. In effect it is only known that this flora is very typical and recalls that of the humid saltmarshes of the Astrakhan government. Its most characteristic species are lepidium latifolium, perfoliatum, leuzea salina, obione verrucifera, plantago cornuti, plantago tenuiflora, salicornia herbacea, salsola, and much more rarely, centaurea glastifolia.

To this characterization of the more or less typical saltmarshes may be added the following features. In the centre of the greater part of the hollows scattered over the said saltmarsh depression occur marshes, ordinarily overgrown with cane and other marsh plants. Their very sloping banks, for a distance of several sagenes from the water, are covered with a thin quartz crust, in places salt to the taste and partly perfectly denuded, partly clothed with different species of chenopodieæ. Only here and there occur more elevated turf-covered areas, overgrown with statice Gmelini, which in its turn, as with a fringe, is surrounded with different chenopods. It is characteristic that these latter, here and here only, attain their normal development and growth, while in other spots, on a sandy crust, no doubt from excess of salt, they assume a dwarfed form. Still higher on the inclines of the hollows, chenopodieæ are met with in small isolated patches over the bottom of the smallest hollows of one square sagene in area. The plantlets are very miserable in size not more than about one inch in height, and never attain complete development and inflorescence. The latter circumstance probably proceeds from the insufficient proportion of salts in the soil required for their full development, and yet too considerable for the ordinary steppe vegetation to appear here.

It is not superfluous to say once more that the saltmarshes described above occur in any quantity only in the low-lying zone of the steppes situated near the Dnieper. In the districts of average elevation, 60 to 75 sagenes, namely Lokhvitsa, Mirgorod, Gadiach, the eastern half of Priluki, in the whole western half of Konstantinograd, they occur in the form of insignificant patches, on the washes and small steppe hollows. Finally, in the districts of Romny, Zienkov, Poltava and the eastern half of Konstantinograd, in general above 75 to 80 sagenes they do not exist at all.

On the whole, the higher the locality, the less the area of saltmarshes, the less typically are they expressed; and this is true of the government of Poltava in general and of each of its districts in particular. Such strict relations between the altitude of a locality, both absolute and relative, and the distribution of saltmarshes were observed earlier in the Ural and Siberia, in the Orenburg government, in that of Chernigov and in the southern part of Saratov. Evidently, this phenomenon is general, equally proper to marine and secondary saltmarshes, the latter of the type of the Poltava government, and beyond doubt connected with the conditions of their formation and continued existence.

Thus, in the Russian fore-steppe, side by side exist four of the grandest floras of the world, the forest, steppe, saltmarsh and tundrabog, of which one is accustomed to see, one in the far, cold and damp north, on the shores of the Arctic Ocean, and another in the very heart of Central Asia, where rain is sometimes unknown for whole years

together. At the same time all these floras, as observed above, occupy in the fore-steppe strictly determined places, possessing a whole series of physical and geological peculiarities, as age of the country, its absolute and relative elevations, or the contour of the locality, soils, ground, water, et cetera.

How is such a curious neighbourhood of salt marsh, forest, steppe, and perhaps tundra, to be explained? How to be understood the wonderfully close connection which evidently exists in the fore-steppe between the character of the vegetation and a whole series of physical and geological local peculiarities, a union so vital that, for example by the mere altitude of the locality, it is possible, if not always at any rate in very many cases, to predict the character of the vegetation and soil, and the geological structure, and vice versa? Can it be, as some think, that climate has no significance either in the distribution of the flora, or in the origin and geography of the soils? Can it be that Nöring, whose brilliant and ingenious hypothesis of the successive replacement in Western Europe of tundra by steppe and forest, made so much noise in the world of science, was wrong, or at any rate his idea inapplicable to Russia? In a word, how is the existence of forest-steppes to be understood and explained?

Leaving to another occasion the examination of this most interesting problem and the general question closely bound up with it of the importance of climate to vegetation, and vice versa, it is impossible here to neglect the indisputably mighty influence which steppe forests must have had upon the water supply of the locality in question. In this respect special attention is due to the following facts, of which some have been comparatively long published, but for some reason or other have not attracted the notice they deserve, while the others have only just been established by science and in particular by experience.

Having pointed out that in the Russian steppes, even in the government of Tambov, that between spring and autumn it is not always possible to reckon upon any, at any rate, considerable rainfall, one investigator naturally comes to the conclusion that the life and abundance of Russian springs and ground waters in general must be largely dependent upon snow water. The following is a case which has furnished him with ocular proof of the justness of this view. In order to protect an enclosure from snow drifts, he planted in the autumn of 1871 a birch folly upon a perfectly level spot, on the south-eastern side of the house which was principally exposed to the wind. After only three years this plantation began to arrest a certain quantity of snow, and after a time the enclosure was almost entirely freed from snow drifts. At the same time, the following characteristic phenomenon was observed: A well which lay in the enclosure, and already in the sixties yielded an insufficient quantity of water twice a year, namely, at midsummer and at the end of winter, during the continued drought of 1871, the date of the planting referred to, completely dried up. During the following years, 1872, 1873 and following years, water appeared again, but as before, in insufficient quantity. The celebrated drought year of 1876 set in. The neighbours began to repeat their complaints that the wells had dried up. However, on enquiry, it proved that there was such a quantity of water in the well as had never, or only very long since, been known.

The explanation of such an unexpected phenomenon proved impossible till attention was directed to the birch folly. Although its edge was distant 60 sagenes from the well, it was evident that only to its influence did the well owe its increase of water, and consequently the rise in the level of the subsoil moisture. In 1885, when,

with the growth of the birch, the level of the water in the well rising with every year, had already reached the point that it became almost inexhaustible, no doubt could any longer be entertained but that this phenomenon was in direct connection with the arrest of snow by trees in a spot whence the water could flow off into the ravine.

Having learned thus, quite accidentally, that a local but very considerable rise of the subsoil water may be attained by such simple means, the investigator referred to determined to apply it to increasing the subterranean moisture on an area set apart for planting a garden. The results not only justified but far exceeded his expectations. First of all, in a level, elevated spot, staked out as a garden, in the winter of 1878 and 1879, a well was dug 14 arshines deep. During the first winter the level of the water rose to one and three-quarters arshines, reckoning from the bottom. Subsequently, the whole area destined for the garden, of about 20 dessiatines, was circumscribed by a ditch, and in some places, following the formation of the ground, light dams were made, so that not one drop of water could leave the garden. The level of the water in 1885, did not fall below 6 to 7 arshines from the bottom. But the process of raising had not yet finished, as the trees that were growing up on the skirt of the garden were holding up the snow more and more every year, in correspondence with which the level of the water also in the well rose every year. Probably five to ten years more will pass before it reaches its highest limit.

One may be convinced, with the author, that the given means will, with time, find a wide application in practice in our southern steppe country, both in horticulture and artificial silviculture, and in the construction of wells. This in the highest degree instructive observation of a local farmer, has received lately complete confirmation on scientific grounds. Thus, according to the exact observations, in February of 1891, in the artificially planted Veliki Anadol forest of the Ekaterinoslav government, there was such a quantity of snow, that on melting, it was capable of yielding, on the average of several observations, 150·6 millimetres of water. In open places, on the other hand, the snow gave only 48·2 millimetres of water. The great store of snow, as was to be expected, after thawing, showed a powerful influence upon the moisture of the forest soil. This moisture was as follows:

March 13th.

	Forest.	Open country.
At a depth of 6 vershoks	24·6 per cent	19·3 per cent
» » » 10 »	23·2 » »	13·18 » »
Average	23·9 » »	16·24 » »

According to the calculation made by Mr. Kostychev, the difference, 23·9—16·24 or 7·7 per cent, in the moisture for a depth of 10 vershoks corresponds to a rainfall of 55 millimetres.

March 20th.

	Forest.	Open country.
At a depth of 2 vershoks	24·5 per cent	23·6 per cent
» » » 6 »	24·4 » »	18·6 » »
» » » 8 »	21·6 » »	13·8 » »
» » » 12 »	18·3 » »	15·3 » »
» » » 16 »	18·4 » »	14·5 » »
Average	21·4 » »	17·2 » »

The difference, 21·4—17·2 or 4·2 per cent, on a layer of soil an arshine deep, corresponds to a rainfall of 50 millimetres. The significance of these figures becomes yet clearer if it be remembered that there fell, also according to Mr. Kostychev, in the same Veliki Anadol forest district, for the whole of last summer, or June, July and August, only 65—66 millimetres. This of course takes place everywhere in the steppes and forests, and most important, this always took place in the course of centuries and millennia. Multiply these same millennia by 50 millimetres of water, and then the extraordinarily characteristic fact will be easy to understand, that in the Poltava forest-lands, alike in the soil and in the subsoil, there is no trace of carbonates till a depth of 5 to 6 feet, while the neighbouring chernoziom lands begin to effervesce with acid, at the most, from a depth of 2 feet. Putting it otherwise, if the whole quantity of carbonate carried by athmospheric water out of the chernoziom of some southern government, taking an area of about 4,500,000 dessiatines, be assumed equivalent to a cube whose side is 850 sagenes, and weight 13,500,000 kilograms, then the similar cube formed of the $CaCO_3$ of the forest lands will be at least three to four times greater. The cause of this is of course clear. In the forests more moisture is collected and more of it enters the soil and subsoil, and therefore more carbonates are carried away from them. It is highly instructive that, in the respect in question, the forest reacts upon its soil in exactly the same way as the water of the temporary lakelets formed in the steppe funnels and hollows; as noticed above, upon their bottom not only the chernoziom itself but its subsoil, approximately to a depth of 6 feet, are almost perfectly devoid of carbonates.

On the other hand, this moisture must contribute to the raising of the level of the subsoil water, the abundance of forest springs, the feeding of forest swamps, lakes and rivers, and their more regular and uniform existence. It should also not be forgotten that forests shelter a locality from sultry parching winds in summer, arrest the movement of sands and the excavation of soils by water. Hence is intelligible the exceedingly important fact that, even in very droughty years, grain and grass in the steppe thrive better near and in the midst of forests, under the shelter of quickset hedges and plantations of trees. It appears that the soil is here comparatively moister.

And as the forest area in the Poltava government was once many times greater than it is at present, it is not difficult to imagine what a wide difference there must be between the state and conditions of existence of subsoil and river waters then and now.

CHAPTER V.

The Fauna of the Steppes.

According to the latest data the most typical contemporary animals of the Russian steppes must be regarded as the following forms, European Russia to the Ural only being considered, and the Tauric Mountains left out of the account: Of mammals, those that live exclusively in the steppe are, erinaceus auritus Pall.; canis corsac Linn. (between the Volga and the Don); fœtorius sarmaticus Pall.; arctomys bobac Pall.; spermophilus guttatus Temm., sp. musicus Men., sp. rufescens Wagn. (Samara government); cricetus frumentarius Pall., cr. accedula Pall. (between the Volga and the Ural); ellobius talpinus Pall.; spalax typhlus Pall., besides the Crimea; alactaga or dipus jaculus Pall., alactaga acontion Pall (between the Volga and the Don); myodes lagurus Pall., (Don and Volga); lagomys pusillus Pall., (now only along the course of the Ural); antilope saiga Pall., (only along the rivers Volga and Don).

Equally characteristic for the open steppes are the following animal forms, among the birds, swimmers being excluded: saxicola isabellina Rüpp., (lower reaches of the Volga), anthus campestris L., melanocorypha Sibirica Gm., mel. Tatarica Pall., calandrella brachydactyla Leisl., cal. pispoletta Pall., melanocorypha calandra Linn., aquila mogilnik Gm., hierofalco saker Gm., perdix cinerea Lath., grus virgo Linn., otis tarda Linn., otis tetrax Linn., glareola melanoptera Nordm., chettusia gregaria Pall.; among the reptiles: eremias arguta Pall., elaphis sauromates Pall., and elaphis Dione Pall., (lower reaches of the Volga).

But it has been already observed above, that in the fore-steppe, forests occupy the same prominent position as typically steppe vegetation. These same, as it were, forest-islands have their own peculiar animal forms, among which, excluding bats, the following are specially typical: felis lynx Linn., mustela martes Briss., mustela foina Briss (in the Poltava government), castor fiber Linn., (forest rivers and lakes, almost exterminated), myoxus glis Linn., nitella Wagn., avellanarius Gm., sciurus vulgaris Linn., capr. capreolus Linn., cervus elaphus Linn. (the Siberian species, C. maral Ogilby, breeds ie forests of the Crimea), and cervus alces Linn., (rarely, in the governments of , Volyn, and Chernigov). The bear, ursus arctos Linn., is met but seldom in the northern icts of the governments of Chernigov, Kiev and Volyn, which however constitute Polessie or Forest Tract, not forest-steppe.

Further, it must be added that the majority of the animals of southern Russia haunt both the forest and the steppes. Such, among the mammals, are: erinaceus Europaeus Linn., crossopus fodiens Pall., crocidura araneus Schreb., crocidura leucodon Herm., sorex pygmaeus Pall., myogale moschata Linn., (basin of the Don and Volga), talpa europaea Linn., (except the Crimea), meles taxus Schreb., fœtorius putorius Linn., erminea Linn., vulgaris Briss., lutreola Linn., lutra vulgaris Erxl., canis lupus Linn, vulpes Linn., lepus timidus Linn., Europaeus Pall., sminthus vagus Pall., cricetus phaeus Pall., arenarius Pall., mus decumanus Pall., rattus Linn., (driven out by the brown rat), musculus Linn., hortulanus Nordm., sylvaticus Linn., (also breeds in fields), minutus Pall., agrarius Pall., hypudaeus amphibius Linn., arvicola arvalis Pall., socialis Pall., glareola Schreb., sus scrofa Linn., (forests and cane thickets in the mouths of rivers); among reptiles: lacerta stirpium Linn., viridis Linn., (excepting the Crimea), vivipara Jacq., anguis fragilis Linn., (except the Crimea), pseudopus apus Pall., coronella laevis Laur., tropidonotus natrix Linn., hydrus Pall., zamenis trabalis Pall., coluber quadrilineatus Pall., Aesculapii Host, vipera berus Linn., cistudo lutaria Mars, rana esculenta Linn., muta Laur., alites obstetricans Linn., (in the Podolian government, but not further east), pelobates fuscus Laur., bombinator igneus Laur., hyla arborea Linn., bufo vulgaris Laur., viridis Linn., triton cristatus Laur., taeniatus Linn.

Regarding exclusively the steppe forms it is necessary to observe that now in the vast majority of cases they are met with in our steppes only sporadically in an association of two or three species. However, even at the present time there are preserved in southern Russia, here and there, remote corners usually with virgin soil, or at any rate, anciently ploughed lands, where simultaneously live, if not the majority of the above mentioned representatives of the steppe fauna, at any rate a very considerable number of them.

And yet such undisturbed corners are rapidly disappearing from the face of steppe Russia and many of the forms mentioned above are undoubtedly dying out, certainly in the more western steppes of European Russia. Thus, the antilope saiga, as late as the time of Beauplan and even Pallas, bred in Little Russia, is now met with only in the Volga and Don steppes. In the first half of the XVII century, Beauplan observed a quantity of arctomys bobac between the Sula and the Supoi in the present districts of Zolotonosha and Piriatin, while now in the Poltava government there remain but a dozen families of this animal in the upper reaches of the river Oriol in the Konstantinograd district. The lagomys pusillus has finally crossed the Volga. The cervus elaphus is finally exterminated. Almost all the remaining forms have undoubtedly changed, it must be supposed, exclusively under the pressure of the farmers, the regions of their habitation migrating mainly to the east and south into less populous and more remote steppes.

The most important indication of this is first of all the so-called krotovinas, surkovinas, or burrows made by rodents. The fact is that the vast majority of the above named, purely steppe animals, not counting of course birds, belong to the rodents that make holes in the earth of various shapes, sizes and depths, sometimes as much as a sagene and more. In the course of time, these subterranean galleries get filled up with vegetable mould, ordinarily chernoziom, and may be preserved in that form sometimes even with remains of the animals for an indefinitely long time, during centuries and millennia, it may be, till the complete extinction of that species to which they be-

long. Now such krotovinas of the most heterogeneous shape, filled up with chernoziom, are met with locally in quantities over the whole chernoziom zone of Russia right up to the extreme northern limits of it, but not farther. Here, not only now but long ago, such builders of burrows as arctomys bobac, in many spots spermophylus musicus and others, have completely disappeared. In this respect especial attention is attracted by the immediate neighbourhood of the village of Verigin in the Arzamas district of the Nizhni-Novgorod government, lying upon the extreme northern limit of the chernoziom, so to say, in the very vestibule of the once existing unbroken coniferous and mixed forests or taiga of the rivers Tesh and Seriozha. Here in the banks of the Veregin Urag a whole series of sections is met with where there was such a mass of krotovinas, and they were traced out with great precision and sharpness, as are rarely observed even in the deep steppe. Some of them had a perfectly round form, and such occurred most frequently of all, others the form of sausages, a third class were oval, the rest quite irregular. Their largest transverse dimensions reached a foot and a half but more often equalled four to six inches. The majority of krotovinas are completely filled up with chernoziom or a heterogeneous mixture thereof with the subsoil, others with sand or clay, both of which with subsoils; a third kind, outside with chernoziom, inside with clay. Further, many of them were variegated with efflorescences of carbonates.

A still more convincing proof of a substantially other distribution over the Russian steppes of the just mentioned fauna is the fossil or half-fossil remains found here and there. Thus according to the data of the literature of the subject it is long known that in the post-tertiary drifts between the Don and Dnieper there have been undoubtedly met remains of the following steppe forms: arctomys bobac, spalax typhlus Pall., diluvii Nordm., meles Storr., spermophilus fossilis Ponticus, lagomys pusillus Pall., equus cabalus fossilis Cuv., asinus fossilis, major et minor, camellus sp. meles taxus and antilope saiga (in a cave).

But it is instructive that in the same undoubtedly post-tertiary formations, more often in lösz but sometimes also in boulder clay, there have been observed the remains of the following forms: elephas primigenius, rhinoceros tichorhinus, bos priscus s. fossilis, castor fiber, probably ovibos moschatus, several species of deer, (among others the reindeer, cervus taraudus), peculiarly frequently, cervus elaphus and its Siberian variety the maral, forms clearly pointing to the more forest than steppe character of the localities where these animals lived. The cervus elaphus from the glacial period to the present time exists in Germany, Switzerland, the Tyrol, Galicia, Bohemia, Hungary, Istria; the cervus maral, in the Caucasus and the Altai, or everywhere in Europe to 65° N. latitude, and in Asia to 55° N. latitude. It prefers mountainous regions with extensive, principally deciduous forests. Precisely such surroundings were once presented in the chernoziom forest-steppe, wooded and hilly right banks of the Dnieper, Vorskla, Sula et cetera, with the neighbouring bank-side forests of the river valleys.

Substantially identical results were obtained also during the labour of the last Soil and Geological Expedition into the Poltava government. Thus, in the freshwater marls of the Romny and Kobeliaki districts were found mammoth tusks; in the level of the boulder clays of the districts of Khorol (Ostapie, Sriednee and the town of Khorol), Priluki (the village of Ladin) and Piriatin (Kalinov bridge), remains of the mammoth, bos primigenius, deer horns and skulls of marmot and beaver. A beautifully preserved skull of the last-named animal was found also near Goustyn in the Pereyaslavl district,

but evidently not in situ. In the lösz of the districts of Zolotonosha, Lubny, Kobeliaki, Poltava, Gadiach, Khorol and Romny, have been found bones of the mammoth and of small rodents, while in the lösz of Bubenkov Yar, near Zhovnin in the Zolotonosha district are buried remains of, at all events, two or three specimens of elephas primigenius, and in Kuleshovka in the Romny district a whole mammoth. At any rate here the owner has even put up a cast-iron monument, upon one of the sides of which is a bronze representation in relief of skeleton of a mammoth with the inscription to the effect that it was found in Kuleshovka in 1846.

But there can be no doubt but that the mammoth and its intimate companions outlived the glacial period in general, and the time of the formation of the lösz in particular. As early as 1878 it was proved by the writer that in the typical lacustro-fluvial formations of the river Kachnya in the Sychev district of the Smolensk government, undoubtedly lying upon boulder clays, occur in splendid preservation rhinoceros and especially mammoth tusks, while the latter have even kept intact their sharp roots and the alveolar mass between them. In 1890, in the village of Zhuravka in the Piriatin district was found, evidently in galley alluvium accompanied by boulders, a quantity of bones which proved to belong to the following animals, elephas primigenius, rhinoceros tichorhinus, bison priscus and cervus tarandus. Finally, along the river washes of the Vorskla, Sula and Psiol are comparatively very widely disseminated mammoth tusks, and especially the horns and whole skulls of the cervus elaphus, cervus maral, and partly also of the bos primigenius, and they are so well preserved that it is difficult to admit that they were imported thence from denuded glacial formations.

CHAI

Climate ol

THE principal features of the climate of the Russian steppes are accurately defined by th

		Temperature[1]. Spring.	Summer.	Autumn.	Winter.	Year.	Vegetative periods.	
Chernoziom zone of Russia.	NORTHERN BORDER-LAND.							
	Basin of Dnieper and Dniester . . .	6·42	19·12	7·19	— 5·64	6·77	Apr.—Nov.	12·43
	Basin of Don and Oka to Volga . .	3·17	17·90	4·37	— 9·93	3·88	Apr.—Oct.	12·05
	Transvolga	1·24	16·71	1·98	—13·76	1·54	Apr.—Oct.	10·38
	Western Siberia . .	0·38	17·03	0·53	—17·36	0·15	Apr.—Oct.	10·34
	CENTRAL ZONE.							
	Basin of Dniester and Dnieper.	8·17	20·41	9·17	— 4·17	8·36	Apr.—Nov.	14·03
	Basin of Don and Oka to Volga . .	4·67	19·07	5·70	— 9·16	5·07	Apr.—Oct.	13·45
	Transvolga. . . .	3·18	19·33	4·32	—12·17	3·67	Apr.—Oct.	13·00
	SOUTHERN BORDER-LAND.							
	Basin of Dniester and Dnieper . . .	8·68	21·95	10·86	— 2·51	9·75	Mar.—Nov.	13·83
	Basin of Don and Oka to Volga . .	7·41	22·12	8·85	— 6·20	8·05	Apr.—Nov.	14·55
	Transvolga.	3·95	21·45	6·02	—11·25	5·04	Apr.—Oct.	14·73
Isolated Chernoziom sections of Russia.	Crimea	9·46	21·23	12·05	0·50	10·81	Mar.—Nov.	14·25
	Northern Caucasus	8·16	19·81	9·69	— 2·88	8·69	Apr.—Nov.	13·94
Chernoziom territories outside Russia.	Danubian lowland .	10·98	21·48	10·95	— 0·88	10·63	Mar.—Nov.	14·47
	North American prairies.	7·32	21·55	9·15	— 6·95	7·77	Apr.—Nov.	14·33

[1] Baranovsky, «Principal features of the Climate of the Chernoziom territories of Russia»
as far as is known, with more or less typical chernoziom soils, exhibit in the main a remarkable
been expected a priori, played an essential part in the formation of chernoziom soil.

TER VI.

he Steppes.

ollowing data, which have been borrowed from the last work of Mr. Baranovsky.

Precipitation.								Humidity.						
Spring.	Summer.	Autumn.	Winter.	Year.	Number of days with precipitation	Vegetative periods.		Spring.	Summer.	Autumn.	Winter.	Year.	Vegetative periods.	
115·6	175·1	122·2	80·1	493·0	127	Apr.—Nov.	386·3	74	66	80	88	77	Apr.—Nov.	72
120·3	190·5	130·4	103·8	545·0	136	Apr.—Oct.	367·0	74	68	81	87	77	Apr.—Oct.	71
91·7	172·6	127·7	77·2	469·2	142	Apr.—Oct.	334·8	73	71	85	87	79	Apr.—Oct.	74
67·4	182·7	98·2	43·3	391·6	115	Apr.—Oct.	311·0	71	70	80	84	76	Apr.—Oct.	71
123·3	171·6	113·8	74·7	483·4	88	Apr.—Nov.	378·6	74	67	79	84	76	Apr.—Nov.	72
103·1	165·4	109·2	88·1	465·8	112	Apr.—Oct.	316·5	73	65	78	84	75	Apr.—Oct.	69
81·0	168·5	108·8	66·1	424·5	108	Apr.—Oct.	309·8	74	64	78	89	76	Apr.—Oct.	68
87·6	131·6	89·3	59·0	367·5	70	Mar.—Nov.	308·5	73	62	76	86	74	Mar.—Nov.	70
90·6	123·2	93·4	81·3	388·5	81	Apr.—Nov.	288·9	74	62	76	86	75	Apr.—Nov.	69
67·7	102·6	87·7	36·5	294·5	93	Apr.—Oct.	216·8	73	58	76	86	74	Apr.—Oct.	65
92·5	150·0	104·1	97·4	444·0	92	Mar.—Nov.	346·6	74	65	76	85	75	Mar.—Nov.	72
100·2	279·4	146·4	88·0	714·0	130	Apr.—Nov.	593·1	77	71	80	86	79	Apr.—Nov.	75
143	183	130	111	567	119	Mar.—Nov.	456	—	—	—	—	—		
178	273	150	86	687	—	Apr.—Nov.	561	—	—	—	—	—		

(1891), says: «Thus it appears that all the localities not only in Russia but outside its limits covered, resemblance in relation to climate. Hence the conclusion is inevitable that climate, as might have

CONCLUSION.

To form some idea of the duration of the period in the course of which might have taken place the most important of the changes in the nature of the Russian steppes mentioned above, the following facts are quoted.

Already in the time of Askold and Dir (865 A.D.) Oleg and Constantine Porphyrogenitus, as well as much later, during the existence of the Transcataract (Cossack) Camp, the ships of the Russi, flat-bottomed dugouts, capable of carrying at the outside from 300 to 500 pouds, were either completely unloaded to pass the Dnieper cataracts, especially Nenasyt, or simply were dragged round by the shore. According to the evidence of Russian annalists, therefore about a thousand years ago, the boundary between the forest and steppe territory, in the main, passed where it does now.

Already in the XI Century, Rus experienced failures of crops from droughts, or as was said, from fine weather. The people themselves, of course not just before the beginning of the geodesic survey of Russia, gave such names to very many Poltava rivers as *sukhaya* (dry), *gnilaya* (rotten), *netiecha* (standing), *slieporod* (blind), et cetera. Even in the time of Herodotus, that is, five centuries before the birth of Christ, perfectly treeless steppes stretched 450 to 500 versts to the north of the Sea of Azov.

During the last Poltava explorations it was established that in the territory of the Poltava forest soils, and consequently also in the territory of the ancient forests, there is not to be met with a single kurgan, a single ancient grave, which are scattered in hundreds over the neighbouring chernoziom steppe. Thus, on going from Poltava to Abazovka, from Machekha to the Lower Zenzhara, from Poltava to Baerak, Novovasilievka and Dikanka, the traveller is simply astonished to see what a point of accuracy is reached on the region in question by the coincidence of forest, clayey soils on the one hand, and the absence of kurgans on the other. To generalize this phenomenon, however, were as yet premature. On all the roads mentioned occurs but one mound, the monument on the field of the battle of Poltava, and a few already destroyed Petrine fortifications. But as soon as the frontiers of the ancient forest island are approached, as soon as the first, not yet decisive signs of chernoziom soils begin to appear, at once not far off but in the chernoziom territory, the traveller is confronted with kurgans, the monuments of high antiquity. They, like a cordon of foresters, once surrounded the prehistoric Poltava forests.

It is clear that when the kurgans were created the forests already existed, and probably had done so for more than one century, while at the same time the kurgans them-

selves, at any rate a considerable part of them, belong to the prehistoric, and partly even to the stone age. Such in fact is the hoar antiquity of the Poltava forests and of the Poltava forest lands.

But, perhaps, even a more venerable age for the forests under consideration is indicated by the following circumstance. It has been already observed in the Nizhni-Novgorod government that under the typical forest lands krotovinas never occur in the subsoil, although steppe plants and chernoziom reach her ein some places far north of the forest lands. With insignificant exceptions, these characteristic galleries of burrowing animals have not been found, moreover, under the Poltava forest soils. This is intelligible for the following reason. The marmots, baibaks and other rodents are inhabitants of the steppes and not of the forests. Such they were formerly, such they have remained now. And as a matter of fact, it is only necessary to hit upon the chernoziom, so to say, kurgan steppe of the Poltava district, where typical krotovinas are met with in hundreds and thousands in any ravine, in any gulley, if their walls be only cleared of turf.

But it is now positively established that there are points in the Russian steppe territory where may be observed the following series of phenomena, in the subsoil burrows, above typical chernoziom, and on the surface, forests. Why then is nothing of the kind met with under the forest soils of the corner of Poltava under consideration as also in the whole of the rest of the government, while around them, especially to the south and west from there, stretch boundless chernoziom steppes, even now unfortunately, in some parts with a considerable quantity of rodents? Why are there no krotovinas, no chernoziom here?

To this but one answer can be given: Here in the region of the Poltava forest lands, if the forests did not exist earlier than the steppe vegetation in the neighbouring chernoziom steppe, at any rate, they appeared simultaneously with it. This simultaneity must of course be understood not on the scale of our years. In other words, the forest lands are probably not younger than the neighbouring chernoziom. But what a venerable age belongs to the latter, is shown by the generally known fact that almost all the kurgans of our steppes with the remains of every kind buried in them, Greek, Scythian and even belonging to the stone age, are erected out of the same chernoziom. This is why it is quite impossible to call those investigators too bold who define the age of Russian chernoziom as at least four to seven thousand years.

But it is possible to glance still further into the depths of ages. The venerable Russian geologist, Professor K. M. Feofilaktov, discovered in the seventies, in the valley of the river Udai in the Lubny district of the Poltava government at the base of the ancient bank formations, probably ravine alluvium, containing the bones of the reindeer, and at least six entire mammoths together with numerous extremely coarsely fashioned stone implements. Both this fact and the remarkable state of perfection of some of the mammoth bones, and the carbonization of others, leave no doubt but that man lived in Little Russia together with the mammoth and the reindeer, the most typical representatives of the glacial period; a similar find was made in the neighbourhood of Kamenets-Podolsk, by the late Count Uvarov, near the village of Karacharov, within two versts of Murom. In the latter spot many bones of rhinoceros and mammoth were even split by the man of the stone age, who also has left here, in this most ancient site in Russia, a multitude of flint paleolithic tools, such as knives, scrapers, and even the remains of a bonfire.

It is thus clear that man was a witness of the existence of the great Scandinavo-Russian glacier at Poltava, and some 100 to 150 versts from Tsaritsyn, and of the not less magnificent Aralo-Caspian Sea at the gates of Saratov, Samara, and even probably Kazan. He was a direct witness of how the Russian rivers were formed, and how the dry land, as it became freed little by little from glaciers and sea, was colonized by animal and vegetable organisms.

How much that would be instructive and impressive the man of the stone age, that contemporary of the mammoth and of the glacial period, could relate, if he had begun earlier and deeper to love and learn the nature of his birthplace.

PART II.

The study of the soil in Russia, its past and present.

AS early as the second half of the last century the Imperial Free Economic Society of St. Petersburg and Mr. Afonin, a professor in the University of Moscow, almost simultaneously directed attention to the importance and necessity of a close investigation of Russian soils in general, and of the chernoziom or black soil in particular. At the same time, schedules were drawn up for the collection of information upon the soils, which were forwarded to the different provinces of the Russian Empire, addressed to governors and other persons of authority. But as far as is known, the real beginning of the systematic gathering of geographical data upon the chernoziom, as also upon other soils, belongs only to the end of the last century, and is due to the statistician of that time, Mr. Storch. Already, according to the account given by that author, chernoziom was known to exist in the governments of Kharkov, Kursk, Orel, Kazan, Penza, Voronezh, Perm and Podolsk, in the southern parts of Tambov and Riazan, and locally in the governments of Kalouga, Viatka and Tauride. Besides this, Mr. Storch recognizes the extreme fertility of the lands, evidently distinguishing them from the non-chernoziom soils, in the governments of northern Novgorod, Simbirsk, Ufa, Kiev, Saratov on the right bank of the Volga, parts of Ekaterinoslav, Irkutsk, Kolyvan, the Caucasus, especially along the Terek, and the Mozdok district, the territory of Don Cossacks and that of Ochakov.

Unfortunately Mr. Storch in his work gives no description of the chernoziom. It is only evident that he distinguishes it from swampy soils and northern clays, sands et cetera. That author does not indicate even approximately the limits of the soil in question. The last mentioned defect of Mr. Storch's work was removed only in 1842, in a special «Map of the industry of European Russia», published by the Ministry of Finance, where occurs the first, albeit very schematic, tracing of the limits of the chernoziom zone.

But undoubtedly one of the first and most important epochs in the history of the study of Russian soils is marked by the compilation and publication in 1851, under the direction of the former Chief of the Statistical Section, now Academician, Mr. Veselovsky, of a general soil map of the whole of European Russia. The Ministry of Crown Domains, in the interval between 1838 and 1848, distributed with this object a detailed map of

Russia, sending it to the governments in which the cadastre existed, to the Commissions for the Assessment of the State peasants with Money Taxes, and in the remaining governments, to the Courts of the Crown Domains, which directed the soils to be entered in it by the officials in their departments best acquainted with the country. These maps, on their receipt in the Department of Agriculture, were compared and verified with the data lying in its archives, as also in the Scientific Committee of the Ministry and in the Central Commission for the Assessment of Money Taxes, and over and above this, with the published works of various men of science who had travelled in Russia, such as Mr. Pallas (for the southern governments), Mr. Ozeretskovsky (for the government of Olonets). Mr. Rychkov (for the government of Orenburg), Mr. Popov and Mr. Moderakh (for the government of Perm), Mr. Murchison and Mr. Blasius (as regards the whole of the chernoziom zone), Mr. Gebel (for the government of Saratov), Mr. Eichwald (for the western governments), and many others. Verified and corrected in this way, the maps were afterwards distributed among farm agents, the corresponding members of the Scientific Committee, some well known farmers, and among Economical Societies and Chief Surveyors, for a second verification on the spot. In the end there appeared manuscript maps of the soils of the governments of Archangel, Astrakhan, Vitebsk, Vilno, Vladimir, Vologda, Volyn, Viatka, Grodno, Ekaterinoslav, Kazan, Kovno, Kostroma, Kiev, Courland, Livonia, Minsk, Moscow, Nizhni-Novgorod, Novgorod, Olonets, Podolsk, Poltava, Pskov, the Nikolaevsk, Novouzensk and Tsarev districts, the northern parts of the government of Tauride, of the governments of Saratov, Tambov, Kherson, Kharkov, Chernigov and Yaroslavl. Upon these maps the following soils were distinguished: a. chernoziom; b. clay; c. sand; d. clayey or sandy soil; e. muddy soil; f. saltmarshes; g. chalk; h. rock.

These were the data which formed the basis of the first «General soil map of European Russia», that of the Academician Mr. Veselovsky, which was ready in manuscript in 1849, and printed and published in 1851. The principal results of Mr. Veselovsky's map are as follows. Beyond the entering upon the map of new types of soil (see above), the chernoziom zone of Russia appears in his map not continuous, as it was shown in the map of 1842, but chequered with a whole series of non-chernoziom soils, clays, clayey soils, stoney spots; its northern and southern boundaries are greatly altered and have also lost their uninterrupted appearance, having become ragged and with portions forming peninsulas. The publication in question was reissued by the Ministry of Crown Domains in 1852 and 1857, but without substantial changes.

Such was essentially the position of the knowledge upon the geography of the chernoziom tract till 1866, when there appeared a new map of the chernoziom zone, compiled by the Academician Mr. Ruprecht. The most important peculiarities of this map are, the correction of the northern chernoziom limit based upon the personal observations of the author, the entering into the map of a series of chernoziom islands far to the north of the continuous chernoziom zone, and chief of all, the application to the study of Russian soils of a purely scientific method of investigation.

It is true that already in the works of Mr. Eversman (1840), Mr. Murchison (1842–1845), Mr. Eichwald (1850), Mr. Borisiak (1852), and a few others, attempts were made to explain the genesis of the Russian soils and to ascertain their types, but this was done feebly, en passant, and upon the basis of too small a number of facts. But the well known botanist Academician, Mr. Ruprecht, started for the south of Russia

with the special object of investigating the chernoziom and personally examined almost the whole northern limit of its occurrence. As a result of his many years labours upon the question appeared the «Geo-botanical investigations of the Chernoziom», which literally forms an epoch in the history of the study of the soil in Russia, and where the author puts for the first time, and partly solves, the questions of the origin of the Russian chernoziom, the dependence of its geographical situation upon the geological structure of Russia, the connection between the chernoziom and a given flora, its age, et cetera.

Soon after the investigations of Mr. Ruprecht, appeared the very important works of the professors Mendeléeff, Ilyenkov, and Levakovsky, the first two giving a series of excellent chemical analyses of the various types of soil in Russia, and throwing light upon the immense importance in the question of the fertility of soils of their zeolithic portion while the latter author enriched the literature of chernoziom with a mass of geological facts.

Almost simultaneously with this, namely in 1869, the Ministry of Crown Domains issued a new soil map of Russia. In a special explanation attached to it Mr. Wilson, the editor of the map, observes: «For the present edition the former map of soils was corrected according to the latest descriptions; thus, for some governments the labours of the Cadastre Commission were taken as a basis, namely for Vladimir, Moscow, Kostroma, Nizhni-Novgorod, Yaroslavl, Kherson, Smolensk, Saratov, Kursk, Tambov, Tauride and Pskov; for other governments the statements of the former map were verified, and in some places corrected, according to the descriptions of the governments, published by the General Staff, the geographical dictionary of the Imperial Russian Geographical Society, and several descriptions and articles by private persons. The labours of the Cadastre Commissions, as expressed in full, and detailed maps, on account of their undoubted accuracy, have been adapted in their entirety».

On the whole, Mr. Wilson's work approaches nearest of all to the maps of 1851 and 1857; the differences consist for the most part in a somewhat different arrangement of the chernoziom islands and the limits of the northern chernoziom zone. However, the compilers of the map of 1869 themselves recognized perfectly that the alterations introduced by them were not final and therefore continued to take great pains in completing the material upon the soil. With this object, in 1873 the Department of Agriculture and Rural Industry distributed instructions to the managers of Crown Domains, as to sending in new maps to the Ministry. Such instructions were forwarded to the managers of Archangel, Vitebsk, Vologda, Viatka, Grodno, Kovno, Livonia, Courland, Esthonia, Minsk, Moghilev, Poltava, Olonets, Orel, Perm, St. Petersburg, Tambov, Tula, Ufa, Orenburg and Chernigov. These maps were received from all the managers, with the exception of those of St. Petersburg and Tambov, some of them sending in special, short explanatory memoranda.

In the interest of the same undertaking, the Editor of the Statistical Section of the Ministry of Crown Domains, Mr. Chaslavsky, examined the material on the soil, existing in the Posts and War Department, studied the accounts of the grain expeditions and the soil maps of several land banks, himself personally visited central and south-western Russia, even including Servia and Roumania. Finally he once more examined the literature upon the soil, paying special attention to the well known works upon the chernoziom by Messrs. Ruprecht and Levakovsky. As the result of all these labours appeared the

new soil map of 1879. The following are the most important peculiarities of Mr. Chaslavsky's map.

1. Besides the Chernoziom islands, already known from the works of Mr. Wilson and Ruprecht, Mr. Chaslavsky shows such in the governments of Viatka, Perm, Kovno, Suwalki, Grodno near Vladimir-Volynsk, and others.

2. On many of the boundaries of the chernoziom zone for the first time is indicated the transition zone, sometimes several tens of versts broad, where the chernoziom gradually and frequently passes imperceptibly into the surrounding soils and mingles with them. These soils are called by Mr. Chaslavsky gray lands.

3. The chernoziom itself is subdivided into nine varieties, and all of them are entered upon the maps separately.*

Of course, all these and similar investigations and attempts, while undoubtedly possessing high qualities for their time, could not yet form a solid foundation for a comprehensive acquaintance with the heterogeneous soils of Russia. Some of the works mentioned were carried out at a time when the scientific study of the soil, not only in Russia but even abroad, hardly existed. Others were compiled mainly from statistics and most important of all, without any chemical and physical analyses of the soils. A third class, among the investigations in question, concerned essentially special although exceedingly important questions in the study of the soil. Finally a fourth category was too schematic, and pursuing exclusively general theoretical objects, and founded upon a comparatively small number of facts.

As was observed above, in this respect a brilliant exception is formed by the labours of Messrs. Ruprecht, Mendeléev, Ilyenkov, and Levakovsky. Mainly thanks to these men, especially to the first of them, from the beginning of the seventies of the present century the study of Russian soils enters into a new phase of its development. Investigations of soils become much more comprehensive, more abundant, fuller, and chief of all, more scientific. The interest in the study of the soil becomes ever more and more general and larger. Works consecrated to the study of soils attract not only the Government and various scientific institutions, but also many zemstvos (local government boards) and private persons. Thus the Imperial Free Economic Society, thanks to the energy and initiative of its former secretary, Mr. Khodnev, and professors Bogdanov and Sovietov, organized in 1877 and 1878 comprehensive investigations of the whole chernoziom zone of Russia, carried out by the author of this article. The same investigations were continued in 1879, also at the expense of the St. Petersburg Society of Naturalists. In the elaboration of the material so collected, professors K. Schmidt and Kostychov, Mr. Krutitsky and Mr. Zalomanov took part most energetically. Members of the St. Petersburg Society of Naturalists, Professor Dokuchaev and his pupils, at the invitation and expense of the zemstvos of Nizhni-Novgorod and Poltava, carry out exceedingly minute investigations of the soils of these governments from the point of view of science and valuation, that of Nizhni-Novgorod having been effected in 1882 and 1886, and that of Poltava in 1887 and 1891. Thus were compiled the first ten-verst soil maps in Russia.

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* The most minute history of the cartographical works upon Russian soils will be found in the «Cartography of Russian soils», 1879, compiled by the author of this article, and edited by A. C. Yermolov.

The Agronomical Cabinet of the University of St. Petersburg, in the person of Professor Sovietov and his pupils, and the School of Forestry in that of Professor Kostychov and his pupils, took a lively part in the laboratory, agronomical and partly in the microbiological investigation of Russian soils. In the laboratory of the Peter Agricultural Academy the methods for the physico-chemical analysis of soils were brought to greater perfection. The Kazan Society of Naturalists organized geo-botanical explorations of the east of Russia under Professor Korzhinsky, and of the soil of Kazan under Professor Stuckenberg and others, with the cooperation of the local zemstvo. The St. Petersburg Society of Naturalists, Kharkov University, and the St. Petersburg Geological Committee produced a series of works and memoirs touching the study of the soil and geo-botanical questions. In Warsaw the local authorities on the soil insist upon the revaluation of Poland after the Nizhni-Novgorod method. In the Yuriev (Dorpat) University, Professor K. Schmidt worked indefatigably at the chemical investigation of Russian soils, while in the Riga Polytechnic, thanks to Professor Toms, a local centre was formed for the study of the soils of the Baltic provinces. Even the soils in far off Eastern Siberia were subjected locally to a fairly circumstantial investigation. Finally, the Academy of Sciences, although not taking any immediate part since the time of Mr. Ruprecht, in the organization of investigations of the soil, did not cease, however, to afford its authoritative cooperation in this matter, by granting the large Makari medal to one of the first great works upon the study of the soil. At the same time very many zemstva and provincial statistical institutions began zealously to gather information upon the local soils, and to accumulate material, valuable in many respects, referring to various localities of European and Asiatic Russia. In this connection, particularly deserving of notice are the labours of the zemstva of Riazan, Kazan and Viatka, as also of the Government statistical expeditions in Western Siberia. Special soil maps and cartograms, on various scales from 5 to 20 versts to the inch, appear in the publications of the Zemstvo Statistical Bureau in Kazan, Chernigov, Viatka and Voronezh. In the Nizhni-Novgorod district, soil maps on a two-verst scale have been drawn. In several governments possessing zemstva, as for example those of Nizhni-Novgorod and Chernigov, investigations of the soil in connection with those upon economical statistics have already served as the basis for the reorganisation of the system of land taxation.

In 1888 in the Imperial Free Economic Society a special Soil Commission was formed with the object of studying Russian soils. Although the means at the disposal of the said Commission are very scanty and uncertain, nevertheless it has equipped a series of excursions to explore the soil, although on a small scale, and many private persons and several zemstva have hastened to apply for its cooperation.

On their part, the Government institutions also have not ceased, in cases requiring it, to invite specialists on the soil to carry out varions investigations. Thus in 1887 and 1890 the Ministries of Crown Domains and of the Interior assigned to the author of this article the necessary means for the physico-chemical investigation of the soils of the tobacco plantations from Asia Minor and Macedonia and of soils from the island of Saghalin. In 1889 and 1890 the Departement of Assessed Taxes of the Ministry of Finance and the Vilno Land Bank raised the question of the standard classification of soils in Poland and the district of Vilno with the object of a uniform taxation of the land. Finally, the practical agricultural importance of investigations of the soil has been directly certified lately by their carrying out on separate private

estates and on Crown experimental farms. Almost all these investigations were effected on a scale of not less than one verst to the inch, consequently in extraordinary detail.

In 1887 a Special Commission consisting mainly of specialists in agronomy, formed at the Agricultural Fair in Kharkov, resolved amongst other things to petition for the compilation of soil maps of all the experimental fields of Russia.

If finally, mention be made of the gathering of data on the soil and of the institution of chemical analyses of soils in various localities of Russia by private persons, amateur naturalists, chemists and foresters, it can but be admitted that the conviction of the importance of the study of Russian soils, in a scientific and practical sense, may be considered to be taking deeper and deeper root in Russian society.

Collections of samples of soils from different governments and territories of Russia exist at the present time in several institutions of St. Petersburg and Moscow, St. Petersburg University, the School of Forestry, the Free Economic Society, the Peter Academy, and in the agronomical and geological cabinets of other universities, among which Kazan deserves special notice. They also exist in such provincial towns as are in no way scientific centres for Russia. In several provincial museums the collections of soils form even the predominant feature. Such for example are the museums in Nizhni-Novgorod and Poltava, partly so in Viatka, Yeniseisk, Minusinsk, Tashkend, Ekaterinburg, and others. At the present time a splendid museum of soils is being organized together with collections of local plants, animals and useful minerals, even by a private person, V. L. Naryshkin, on his well-known estate, Pady, district of Balashov, government of Saratov. Nevertheless, collections representing more or less fully the soils of the whole of Russia, do not as yet exist anywhere in the Empire.

As regards the contemporary literature of the Science of the Soil in Russia, besides a series of isolated scientific monographs, such as The Russian Chernoziom; The question of the Siberian Chernoziom; Methods of investigation of the question: Were there forests in southern steppe Russia?; Our Steppes, Formerly and To-day; On the relations between the age and height of a locality, on the one hand, and the character and distribution of the soils, on the other, (Dokuchaev); Soils of the chernoziom zone of Russia; Connection between soils and certain vegetable formations; On certain properties and the composition of chernoziom (Kostychev); Cartography of the soils of Western Europe (Loevinsohn-Lessing); Geo-botanical investigations, (Korzhinsky); The question of the age of soils (Agafonov); Micro-organisms of soils (Ivanovsky); Podzol (or sour soil) (Georgievsky); Soils of the government of Kazan (Rizpolozhensky); Influence of winds upon soil (Bychikhin); On the question of the chernoziom (Levakovsky), devoted to fundamental * questions concerning the soil, there exist numerous and various investigations and articles bearing upon the question not only in different scientific works on natural science and rural economy, but also in zemstvo and statistical publications, such as Materials for the valuation of Lands, in

* Of the articles treating of the chernoziom purely from the point of view of agronomical science, valuation and other practical questions, it will here suffice to mention the articles by Kostychev, «On the question of manure and tillage in reference to chernoziom soils», 1888; «On the question of the tillage of chernoziom soils», 1891; Engelhardt, «The importance of soil and geological investigations for agriculture», 1891; Dokuchaev, «On the standard valuation of the soils of European Russia».

the governments of Nizhni-Novgorod and Poltava, summaries of economical statistics for a whole series of governments possessing zemstva, and so on. The Professors of St. Petersburg University, Mr. A. Sovietov and Mr. V. Dokuchaev, have moreover started a special publication, Materials for the study of Russian Soils, appearing at irregular intervals in separate parts. But on the whole, alike in these publications and works as in others due to Russian students of the soil, the largely predominating theme is the chernoziom, a phenomenon which is perfectly intelligible. In order to show this at a glance it is enough to enumerate here the names of these men of science who have essayed to resolve the great question of the origin of the Russian·Chernoziom. The following is the list: Hildenstedt (1787), Pallas (1799), Herman (1836—7), Eversman (1840), Guyot (1842), Murchison (1842 and 1845), Chernyaev (1845), Eichwaldt (1850), Petzholdt (1851), Borisiak (1852), A. P. (1853), Wangenheim von Kwalen (1853), Pacht (1856), Ludwig (1862), Romanovsky (1863), Ruprecht (1866), Bogdanov (1871), Karpinsky (1873), Ort (1877), Stuckenberg (1877), Schmidt (1879—81), and Agapitov (1881). Hither should also be added Messrs. Zalomanov, Korzhinsky, Kostychev and the author of the present article.

What a need is felt in Russia for an active exchange of opinions, observations and results in regard to the study of the soil, may be seen from the fact that at the last Congress of Naturalists in St. Petersburg, when the Section of Agronomy was opened for the first time, communications upon questions of soil at once formed about fifty per cent of all the papers read in this new section, although it was not a special section for the discussion of this subject.

The same section gave a sympathetic hearing to, and accepted in principle, the proposition of Professor Bogdanov for the publication of an Agronomical Summary with a special section on the soil. Be it added to what has been already said that only lately an independent chair of the science of the soil has been founded at the New Alexandria School of Agriculture, and the Imperially instituted Commission upon higher agricultural education in Russia has resolved to raise the question of establishing similar chairs in all the Russian universities.

Reducing all the above set forth to one result, it may be said that the existing investigations on the soil and materials gathered, as well as the problems proposed for solution, give the science of the soil in Russia an independent and honourable place.

The study of the soil in Russia possesses such a considerable and independent literature that already for the survey of its bibliography special sections are set apart in the Russian Geological Library, in the Messenger of Natural Science, in the publications of the Department of Agriculture and Rural Industry, and partly also in the special summaries published by the Imperial Geographical Society.

In conclusion to this cursory historical sketch of the Russian Science of the Soil, it is not out of place to say a word on the tendency and general character which pertain to the vast majority of the works of Russian students of the soil, during the last fifteen or twenty years, and which really give to the Russian science an undoubted and honourable place among its brethren abroad. Briefly told, the above mentioned tendency and character may be expressed by the following propositions.

1. The soil is a completely independent, natural, historical body, resulting from the combined action of: a. ground, b. climate, c. animals and plants, d. age of the